Rose-Hulman Institute of Technology
Rose-Hulman Scholar

Technic Student Newspaper

Spring 4-1961

Volume 72 - Issue 7 - April, 1961

Rose Technic Staff
Rose-Hulman Institute of Technology

Follow this and additional works at: https://scholar.rose-hulman.edu/technic

Recommended Citation

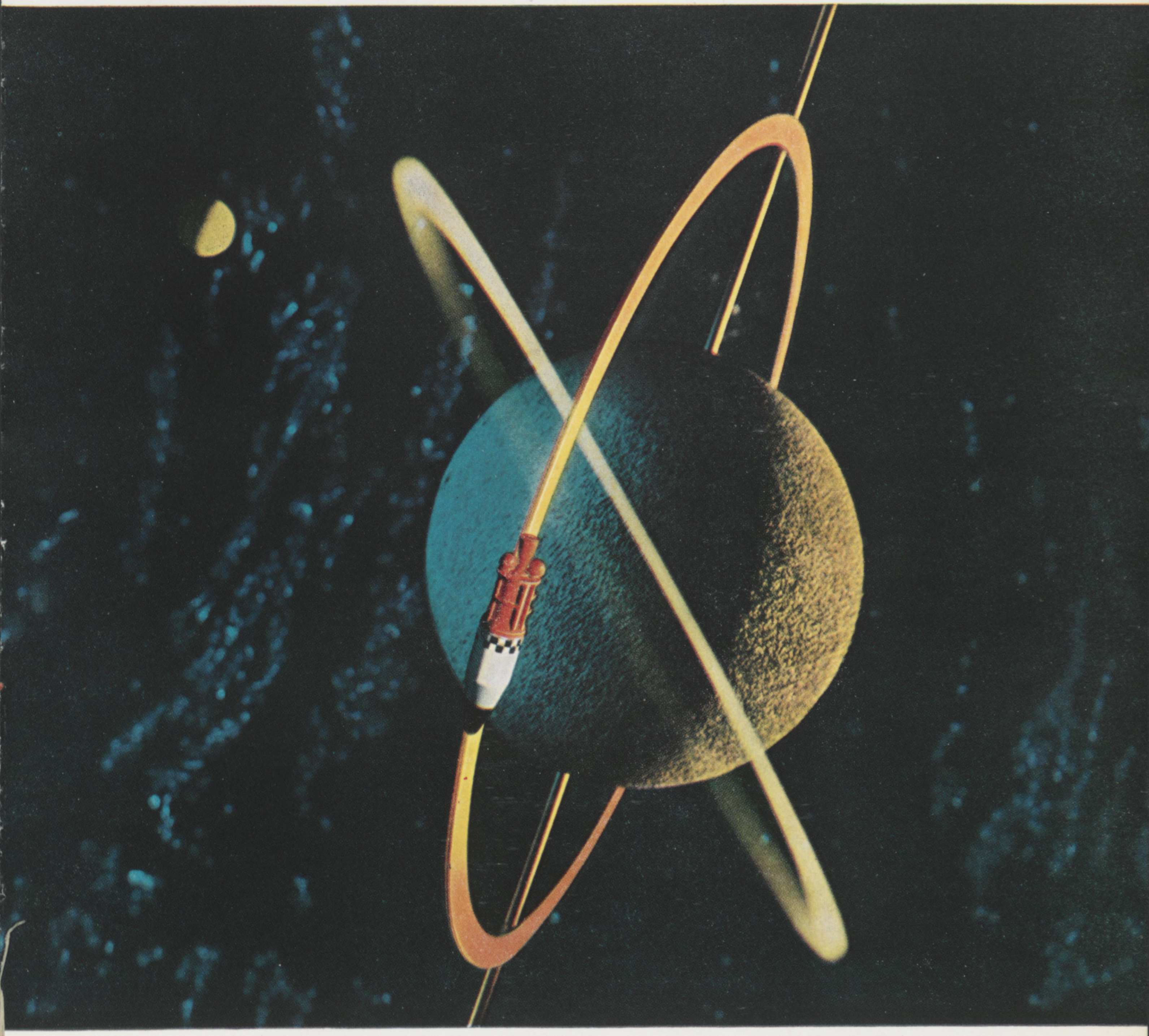
Staff, Rose Technic, "Volume 72 - Issue 7 - April, 1961" (1961). *Technic*. 156.
https://scholar.rose-hulman.edu/technic/156

Disclaimer: Archived issues of the Rose-Hulman yearbook, which were compiled by students, may contain stereotyped, insensitive or inappropriate content, such as images, that reflected prejudicial attitudes of their day--attitudes that should not have been acceptable then, and which would be widely condemned by today's standards. Rose-Hulman is presenting the yearbooks as originally published because they are an archival record of a point in time. To remove offensive material now would, in essence, sanitize history by erasing the stereotypes and prejudices from historical record as if they never existed.

This Book is brought to you for free and open access by the Student Newspaper at Rose-Hulman Scholar. It has been accepted for inclusion in Technic by an authorized administrator of Rose-Hulman Scholar. For more information, please contact weir1@rose-hulman.edu.

Rose Technic

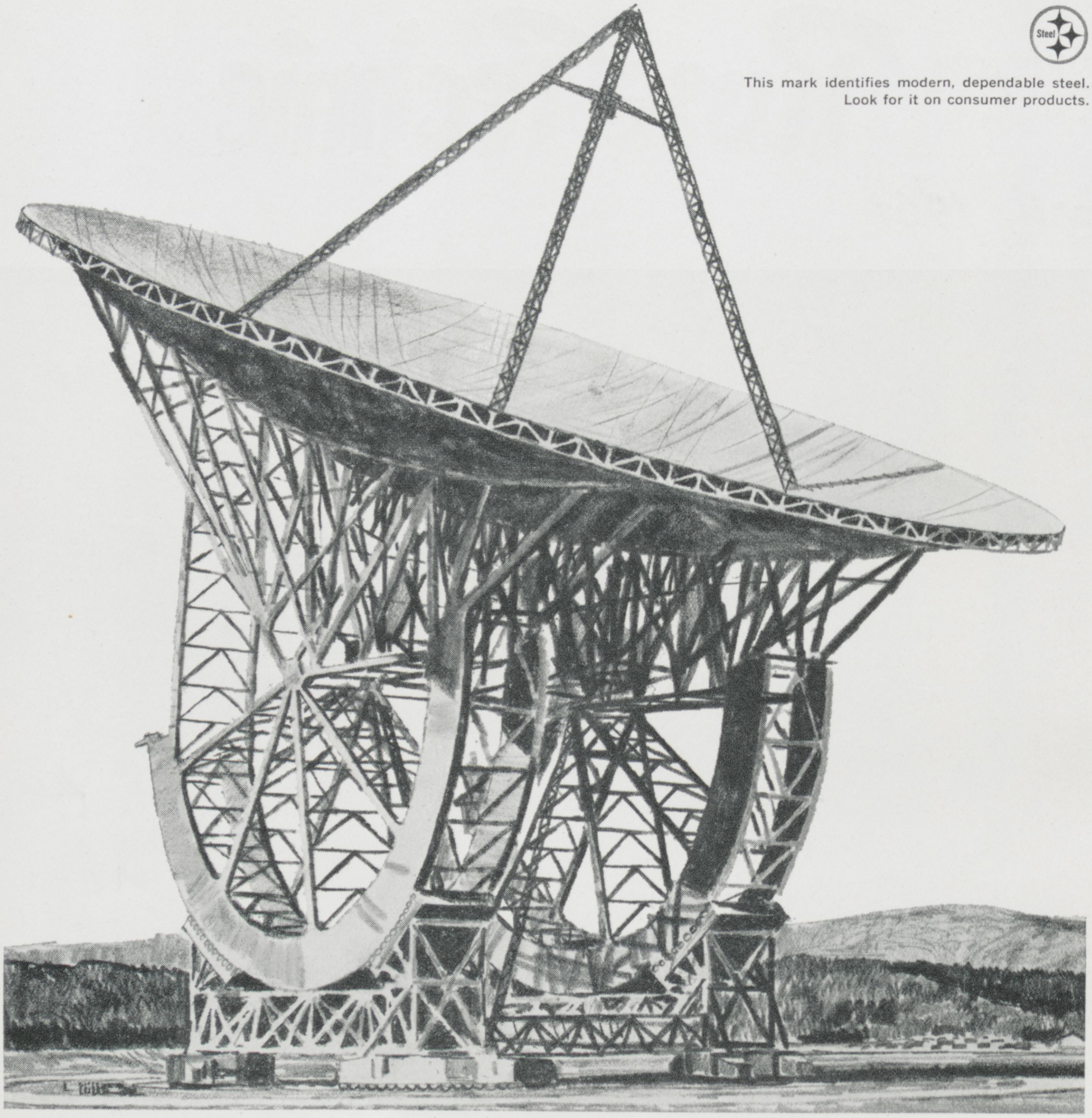
April, 1961



In This Issue

ABSTRACT VS. CONCRETE
PRODUCTION MANAGEMENT
MECHANICAL TEACHERS

This mark identifies modern, dependable steel.
Look for it on consumer products.



This is an artist's concept of the world's biggest radio telescope

This giant telescope will use radio waves to locate objects that are billions of light years out in space. The dish-shaped mirror will be 600 feet in diameter—about the size of Yankee Stadium. It will be the biggest movable radio telescope ever known.

As you'd imagine, it is going to take a lot of material to build an instrument this size. The American Bridge Division of United States Steel, as a major subcontractor, is fabricating and erecting 20,000 tons of structural steel for the framework alone. The U. S. Navy through the prime contractor is supervising the entire job. When it's completed, there'll be a power plant, office buildings and personnel facilities for a permanent 500-man crew. The site is near Sugar Grove, West Virginia.

United States Steel produces many of the materials that are essential for construction: Structural carbon steel; high strength steels; alloy steels; stainless steels; steel piling; steel drainage products; cements; slag; reinforcing bars; welded wire fabric; wire rope; steel fence; electrical cable; and other allied products.

The most important building projects in our nation depend on steel. And *steel* depends on men like you. If you would like to find out about the many engineering, financial analysis or sales career opportunities at U. S. Steel, send the coupon.

USS is a registered trademark

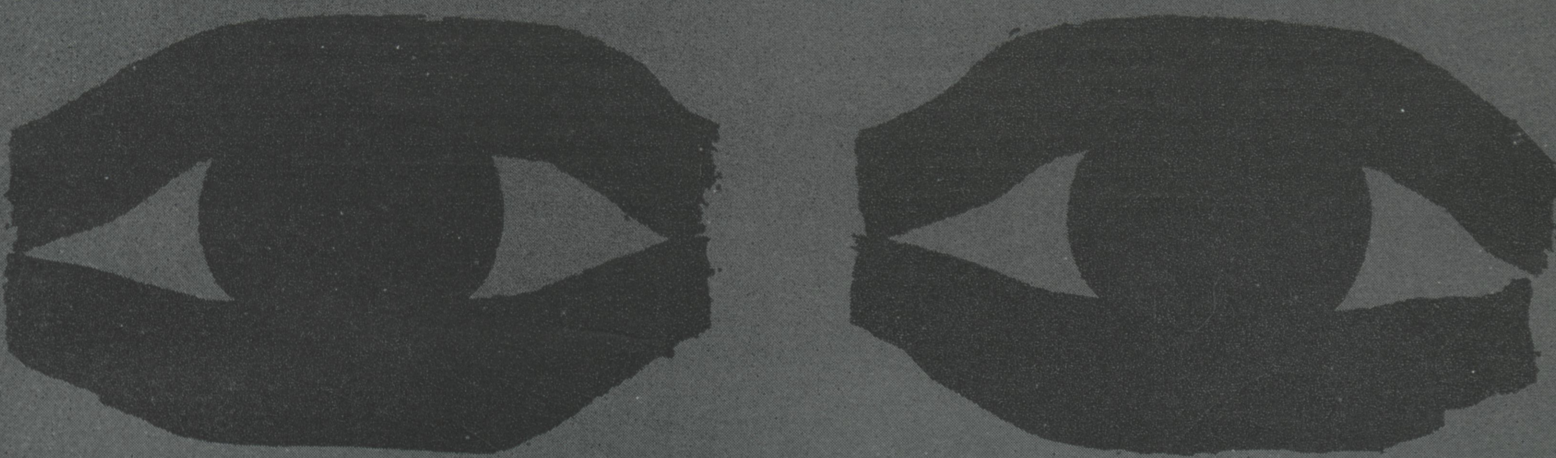
United States Steel Corporation
Personnel Division, Room 6250
525 William Penn Place
Pittsburgh 30, Pennsylvania

Please send me career information about U. S. Steel.

Name__________
School__________
Address__________
City_____ Zone____ State_____

USS United States Steel

Things We Know About Tomorrow



EYES MADE FOR DARKNESS Westinghouse scientists expect that airplane pilots are going to be able to see the ground clearly on a cloudy, moonless night. Astronomers will be able to see vastly beyond the present range of their telescopes, perhaps to the final boundary of the universe, if there is one. Policemen will peer into dark alleys and see through special binoculars. Scientists at Westinghouse are working on the proposition that no matter how dark it looks to us, there is plenty of "light" everywhere: on a black night, in a coal mine, in a sealed room. We just have the wrong kind of eyes to see it all. So they have developed a device that "sees" infrared light which we can sense only as heat...another device that "sees" ultraviolet light, which we can detect only when it gives us sunburn...still another that picks up a single "packet" of light, the smallest amount that can exist, and multiplies it into a visible flash. You can be sure...if it's **Westinghouse**

hoernle

ENGINEERS: For full information on rewarding career opportunities at Westinghouse write to L. H. Noggle, Westinghouse Educational Department, Ardmore & Brinton Roads, Pittsburgh 21, Pa.

IMPORTANT DEVELOPMENTS AT JPL...

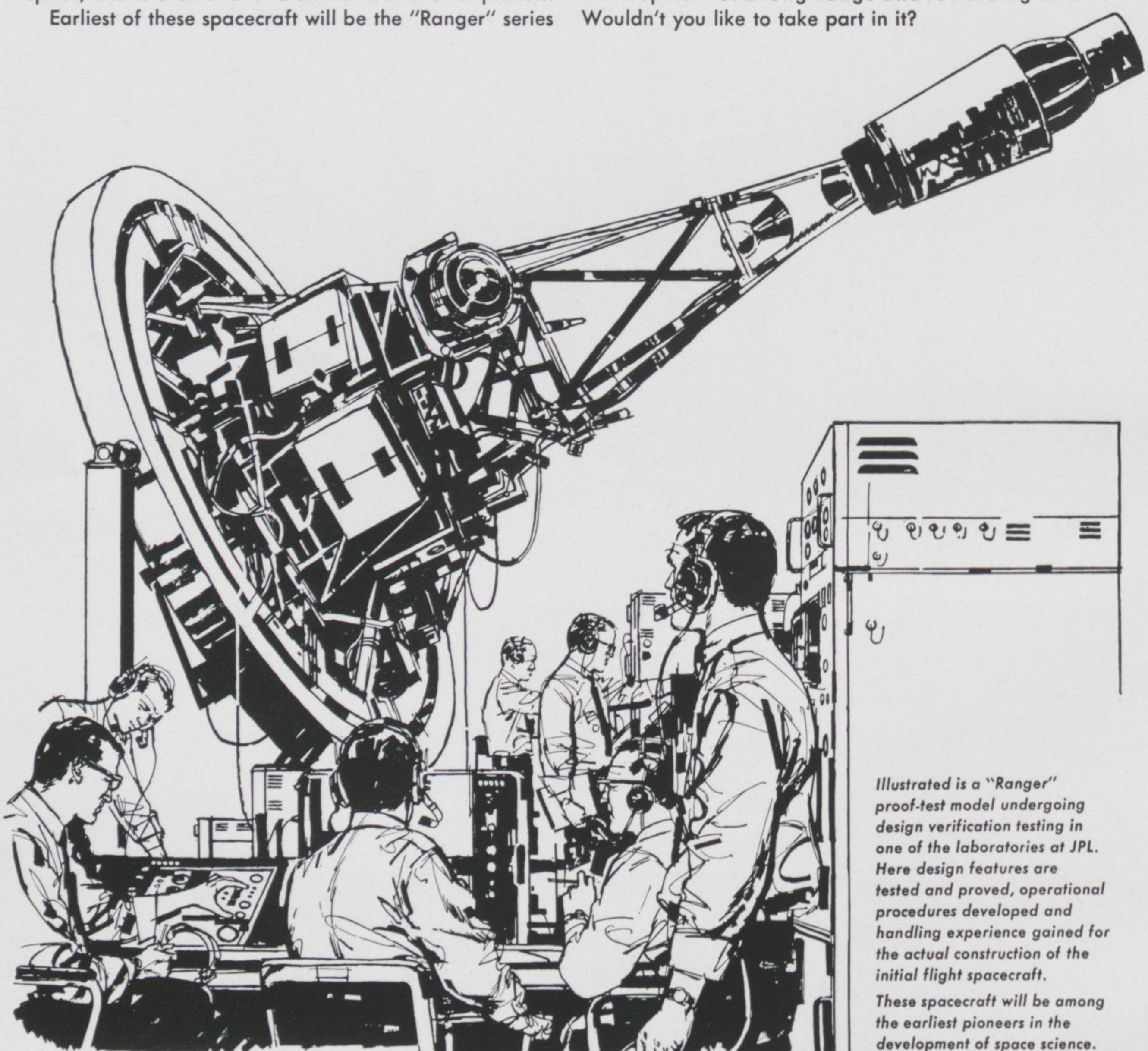
PIONEERING IN SPACE RESEARCH

The Jet Propulsion Laboratory has been assigned responsibility for the Nation's program of unmanned lunar, planetary, and interplanetary exploration. The objectives of this program are to contribute to mankind's fundamental knowledge of space and the space environment and to contribute to the development of the technology of space exploration. For the next ten years, as larger booster vehicles become available, increasingly versatile spacecraft payloads will be developed.

JPL will conduct the missions, utilizing these spacecraft to orbit and land on the moon, to probe interplanetary space, and to orbit and land on the near and far planets.

Earliest of these spacecraft will be the "Ranger" series now being designed, developed and tested at JPL. The mission of this particular series will include first, exploration of the environment and later the landing of instrumented capsules on the moon.

Never before has such a wide vista of opportunity, or a greater incentive been open to men trained in all fields of modern science and engineering. Every day at JPL new problems arise, new theories are advanced, new methods tested, new materials used and new principles discovered. This creates a stimulating work atmosphere for trained individuals and an unlimited field for constructive development of a long-range and rewarding career. Wouldn't you like to take part in it?



Illustrated is a "Ranger" proof-test model undergoing design verification testing in one of the laboratories at JPL. Here design features are tested and proved, operational procedures developed and handling experience gained for the actual construction of the initial flight spacecraft.

These spacecraft will be among the earliest pioneers in the development of space science.

JET PROPULSION LABORATORY

Operated by the California Institute of Technology under contract with the National Aeronautics and Space Administration

PASADENA, CALIFORNIA

Employment opportunities for Graduate Students in these fields

INFRA-RED • OPTICS • MICROWAVE • SERVOMECHANISMS • COMPUTERS • LIQUID AND SOLID PROPULSION • STRUCTURES • CHEMISTRY
INSTRUMENTATION • MATHEMATICS • ENGINEERING MECHANICS • TRANSISTOR CIRCUITRY AND SOLID STATE PHYSICS

Send professional resumé for our immediate consideration. Interviews may be arranged on Campus or at the Laboratory.

Rose Technic

VOLUME LXXII, NO. 7 APRIL, 1961

EDITOR-IN-CHIEF:
T. C. COPELAND

ASSOCIATE EDITOR:
MAX GOODWIN

BUSINESS MANAGER:
DALE OEXMANN

STUDENT ADVISORS:
DAVID TRUEB
JAMES FUNK

FACULTY ADVISOR:
PROF. CARL D. MUNSELLE

EDITORIAL STAFF:
Joe Grumme
Mike Thomas
Rich Daugherty

CONTRIBUTING STAFF:
DON BONNESS
Ken Miller
Bob Valle
Lindley Ruddick
Jerry Badger
Merle Rice
Dave Morgan

FEATURE STAFF:
FRED WRIGHT
Ken Miller

ADVERTISING STAFF:
JACK MUNRO
Al Jannasch
Mike Scherer

CIRCULATION STAFF:
RICK RAPSON
Mike Thomas

ART STAFF:
TOM BOSWORTH

PHOTOGRAPHY:
Andy Breece

Member of
Engineering College Magazines
Associated

Publisher's Representative
LITTELL-MURRAY-BARNHILL, INC.
369 Lexington Avenue,
N. Y. 17, N. Y.
and 737 N. Michigan Avenue,
Chicago 11, Illinois

Contents

Cover Note

"Discoverer-Agena satellites," powered by Bell liquid rocket engine, symbolized in orbit.

PRINTED BY MOORE-LANGEN PRINTING AND PUBLISHING CO.
140 North Sixth Street, Terre Haute, Ind.

Published monthly except June, July, August, and September by the Students of Rose Polytechnic Institute. Subscription $2.00 per year. Address all communications to the ROSE TECHNIC, Rose Polytechnic Institute, Terre Haute, Indiana.

Entered in the Post-office at Terre Haute as second-class matter, as a monthly during the school year, under the act of March 3, 1879. Acceptance for mailing at special rate of postage provided for in section 1103, Act of October 3, 1917, authorized December 13, 1918. This magazine does not necessarily agree with the opinions expressed by its contributors.

LETTERS TO

Dear Editor:

During the past several years attendance at convocations has been the subject of many discussions around Rose. It seems that attendance has been declining steadily, and it is in such a poor state that it looks as if someone will have to take definite action to alleviate the situation.

What are the excuses for not attending convos? There are three major excuses:
(1) the convos take up time that could be employed in a more advantageous way.
(2) the convos are uninteresting, the subject matter boreing.
(3) there are too many convos that reflect the feelings of only one political faction.

In answer to the first excuse, the time that is spent in convos should have exactly the same importance as that spent in Physics class, Math class, or any of our other classes. Rose convos are designed as part of the academic curriculum, to give the student background in fields that he does not get in other subjects.

That convos are uninteresting is largely the fault of the students themselves. It is true that every convo can not consist of subject matter that interests every student, but even these students can not be uninterested until they attend the convo and know what they are uninterested in. Here at Rose we have the right to choose our own topics and speakers at the convos. Let a member of the Convocations Committee (there are two student members) know who and what you want. This is something that few of us take advantage of.

The third excuse is perhaps the only one that carries any weight. It is unfortunate that we sometimes hear only one side of the political story (over and over and over), but it is a fact that some of our convos are financed by grants, and sometimes the grantor will choose to make only one political viewpoint available to us in the convos he sponsors. However, if we want it, the Convocations committee will do everything they can to make other political feelings available.

The faculty does not want to make convocation attendance mandatory, but the way things look now they will probably have to. The attendance has become so poor that Rose is having trouble acquiring speakers, for we cannot guarantee the speaker an audience of more than 50 or 60.

There are two proposals for requiring attendance. The first was done at Rose in the past, and entails a member of the faculty at the door taking attendance. When a student exceeds a prescribed number of cuts, he is assigned extra credit hours for his graduation requirement. In other words, he will have to take extra courses, probably in humanities, before he can graduate.

The other method is employed by setting up a required, one or two credit hour course that meets the fourth hour on Tuesdays and Thursdays, except when there is a convo. Tests will be given on the subject matter of the convos and at the regular meetings of the class various faculty members and outside speakers will address the students on various humanities subjects.

Each of us owes it to himself to attend convos. We are paying for them, why not take advantage?

Yours truly,

Joseph G. Grumme

THE EDITOR

Dear Editor:

Rose Poly is considered among the outstanding engineering schools in the United States. We realize that Rose must continually change in order to remain an outstanding school, but at times we question the direction of some of the changes. In the following paragraphs are some of the questons that are foremost in our minds.

At the end of last semester we note that only two freshmen failed to meet minimum scholastic requirements. This compares with 18 sophomores, 4 juniors, and seven seniors who failed to meet minimum requirements for the same period. Is this low drop-out rate in the freshman class the result of higher entrance requirements and improved counciling, or is it the result of some departments being urged to reconsider their number of failing grades. We wonder if the Rose faculty has retained the same scholastic freedom that it has had in previous years.

One thing that is very evident and very much a cause for concern is the present disagreement of faculty members with administrative attitudes and policies. There is a persistent rumor that we are losing several members of the faculty at the end of this school year. If this is true, it is very unfortunate. To our knowledge, there has seldom been such acute dissatisfaction among the Rose faculty.

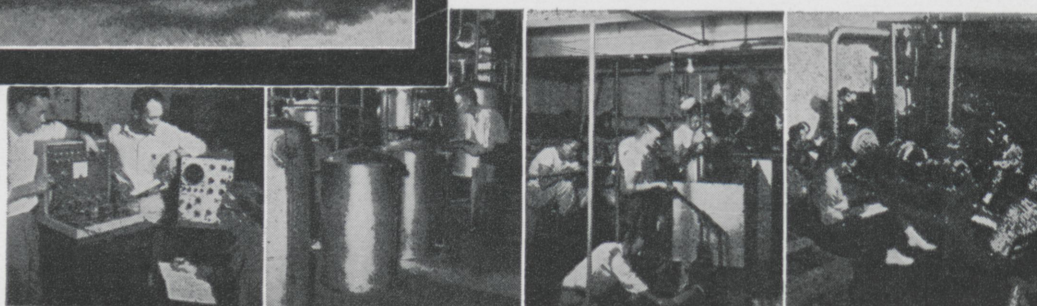
This brings up another point. In the hiring of faculty members in the future, what will be the criteria for employment .Are they going to be hired with the idea that they engage in individual research, as the school seems to be presently proposing, or for their ability to teach and work directly with the students? It seems that instead of hiring a number of men to do research, the money would be better spent by raising the salaries paid to full time instructors, thus keeping the good men we have at present and enabling us to obtain competent men in the future. This would be rewarding the faculty not for how much they know, but for how well they can convey this knowledge to the students. We want to maintain Rose's reputation on the ability of the graduates to perform in industry, not by emphasis on the accomplishments and publications of the faculty. We are definitely not against the policy of the faculty members obtaining advanced degrees, but we do not feel the present balance of de-emphasis on teaching experience and increased emphasis on advanced degrees and publications in determining salaries is a step in the right direction.

Is Rose being patterned after other schools? If so, why. We feel that Rose can maintain its present individuality and still be recognized as a leader among engineering colleges.

Ed Ayers

Jon Stiles

ROSE



ROSE POLYTECHNIC INSTITUTE

TERRE HAUTE, INDIANA

HIGH SCHOOL GRADUATES OF 1961

You are cordially invited to visit Rose Polytechnic Institute where you can earn a degree in:

CHEMICAL ENGINEERING
ELECTRICAL ENGINEERING
MECHANICAL ENGINEERING
CIVIL ENGINEERING
MATHEMATICS
PHYSICS
CHEMISTRY

Office OF ADMISSIONS

ROSE POLYTECHNIC
INSTITUTE
TERRE HAUTE, INDIANA

In Defense of Four-Hour Finals

No sooner will the disappointments of twelve weeks grades be forgotten than Rose will again face the prospect of long, hard final exams. Students will cringe at thoughts of how much they have forgotten, professors will ponder the agonizing task of grading four-hour examinations, and all of us will inevitably ask ourselves, "Are four-hour finals worth it?"

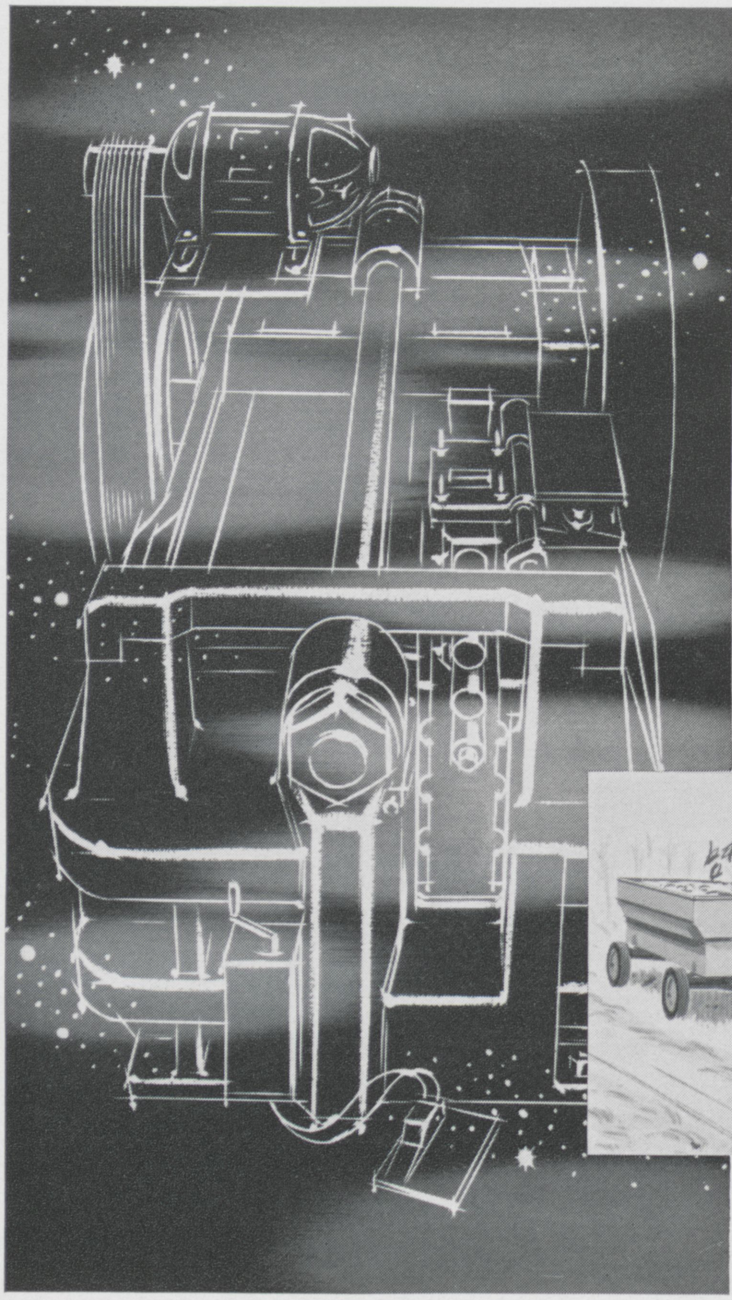
Comprehensive final exams are "worth it," for several reasons. First, since the student knows that he will be tested on his work at the end of the semester, he is encouraged to learn the material thoroughly, not just to cram for an hour exam and then forget it. Second, preparing for final exams forces the student to review a whole semester's work. This enables the student to place each section of the course in its overall context and view the material in its proper perspective. Most important, finals reward the person who actually has *learned* the material in his courses. While class attendance, attitude, working speed, and other factors may have a legitimate place in the grading system, it is what the student knows about his courses at the end of the semester that is most important.

Why four-hour finals? Simply because that much time is required to obtain a fair indication of what a student has learned in seventeen weeks of a four or five credit course. If the test time is shorter, either the exam is not comprehensive, which is unfair, or the student is required to work as fast as possible. Since hour exams test working speed all semester, it seems only fair that sufficient time should be given on the final so that speed is only a minor factor.

There are two main arguments against finals. The really important one is that they place an even heavier burden on a generally over-worked faculty. This problem certainly deserves attention, but it should be attacked from a direction which will not lessen the effectiveness of finals. Student help in grading and paper work might be of value. The most promising idea seems to be to find ways to write good comprehensive exams which can be quickly graded either by hand or machine.

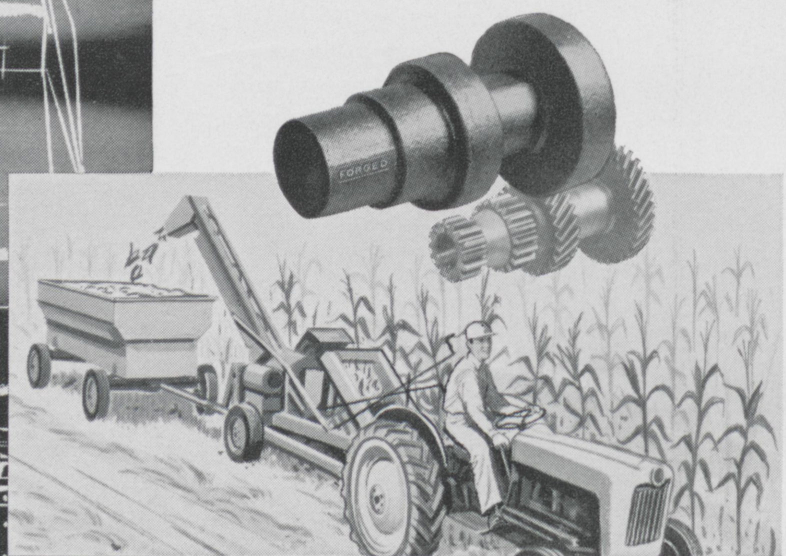
The other argument is that finals make life more difficult for students. No one will deny this fact, but it is no reason to abandon four-hour finals. Rose men expect to work harder than students elsewhere, because we feel that hard work is the most important ingredient in Rose's formula for turning out the best engineers and scientists. For that, four-hour finals are a small price to pay.

M. E. G.



Upsetter, or horizontal forging machine

RESISTANCE TO PUNISHMENT of any severe-service part increased by designing it to be forged



Gear blanks for tractor and farm implement transmissions are designed to be upset-forged, usually with integral forged stub shafts. Forging gives these vital parts maximum resistance to gear-clashing shifts. Transmission life can be equal to equipment life when gears are FORGED.

When you *design with forgings* right from the start, you take full advantage of the many benefits which only forgings offer: highest ratio of strength to weight . . . highest resistance to impact, shock, vibration, torsion . . . preferential orientation of flow lines in the forging to concentrate strength where required . . . absence of wasteful inclusions and voids.

Forged parts start out as *better* metal . . . are made *even better* by the hammer blows or pressures of the forging process. Write for literature to help you design, specify, and procure forged parts.

When it's a vital part, design it to be FORGED

Drop Forging Association • Cleveland 13, Ohio

Names of sponsoring companies on request to this magazine

From the

PRESIDENT'S DESK

Recently Professor Bloxsome has been preparing some statistics on the professional accomplishments of Rose graduates. The one outstanding factor that comes to light from these studies is the high level of attainment, both professionally and financially, which they achieve.

Such recognition indicates that the quality of the student body and the education received at Rose over the years has been high. When compared to the national average of engineering and science graduates, more Rose graduates remain in the kind of positions which require strong scientific and engineering backgrounds than is the case with graduates in science and engineering of many of our sister institutions. In the past twenty years a smaller number of graduates of Rose has been engaged in non-technical pursuits than was the case in earlier years. This is a challenge to the Faculty to maintain the quality of education in this rapidly changing world. In order to maintain this quality new items have to be added constantly to the curricula and many of the older traditional courses have to be eliminated. This places an increasing obligation to select students who can profit from this type of education.

There are two ways to maintain this high quality. One method is to hold admission standards constant and admit a large number of freshmen. Permit these students to compete at the level of instruction which Rose must achieve to maintain top quality. Then those who are unable to maintain the pace are eliminated through academic failure. This is a wasteful procedure, both from the standpoint of manpower and dollars. With the funds available the privately supported colleges cannot afford this luxury even though a few late bloomers may be recovered.

The second way to maintain quality is to raise admission standards to the point where assurance is given that anyone who is admitted can graduate if he will study and apply himself. This is the course which Rose has chosen to take.

Two major criteria are used in determining eligibility for entrance to Rose. First, the applicant must pass the CEEB Mathematics and Verbal Scholarship Aptitude Tests with a creditable score and second, he must have maintained a high standing in the secondary school from which he is about to graduate. The Freshman Class which entered in September 1960, for example, had a mean average score on the CEEB examinations of fifty points higher than the Freshman Class which entered in September 1959. In addition, the standing in the high school class was more than four percentile higher than the previous year. It is encouraging to note that the applications for admissions for the class in September 1961 are even higher in both categories than those of last year.

It can be said, then, that on the basis of the two test criteria, CEEB and standing in the high schools, any student who enters Rose can do the work if he will apply himself.

This missing ingredient is how to motivate those students who can do well but won't apply themselves. If anyone knows how to test for this missing ingredient, he will provide the key to the major stumbling block to educational progress. We are hopeful that our improved counseling system will be helpful in this respect.

R A Morgan

OBSERVATIONS of SUCCESS

PART VII: PRODUCTION MANAGEMENT

by Mr. Donald E. Alexander
Product Planning Manager
Moto-Mower, Inc.

"OBSERVATIONS OF SUCCESS" is a series written by outstanding alumni of Rose—men who are truly giants in their ifelds—to describe for you the nature of their particular field of engineering, the elements of their college training which were most helpful to them, and the traits of their personalities which were invaluable to their success.

Because ultimate job satisfaction cannot be obtained unless the philosophy of the man parallels that of the organization for which he works, it would be well to consider the values which these authors attach to things as evidenced in their writing in the thinking that precedes your selection of a field of engineering.

This momentous series will represent the most current, the most broad, and the most highly authoritative opinion available on any college campus of activities emanating from Engineering.

Donald E. Alexander, who is Product Planning Manager of Moto-Mower, Inc., Richmond, Indiana, a subsidiary of Dura Corporation of Detroit, was born in Muncie, Indiana on March 30, 1924, and was educated in Indianapolis and Richmond public schools. After completing five semesters at Rose Polytechnic Institute, he was sent to Purdue University as a student in the Naval College Training Program. With the completion of two and a half years of continual study, he was given the unusual option of the choice of his alma mater. Grateful to Purdue, he selected the college of his original choice, and received a B.S. in Mechanical Engineering from Rose with the class of July 1944.

After a short course in Marine Engineering at the U. S. Naval Academy at Annapolis, he was commissioned in the Naval Reserve and served as engineering officer of a destroyer in the Pacific theater, and then in the Atlantic as Chief Engineer of the Joseph Campbell, an attack transport named after a native of Terre Haute. Since his discharge from the navy, he has taken several courses in business administration at Earlham College and is an avid supporter of the Dale Carnegie courses, of which he has been a student and an assistant instructor.

He was a senior process (methods) engineer at Crosley Division of AVCO and joined Moto-Mower in 1953 as chief inspector to establish their first quality control program upon the acquisition of the company by Dura Corporation. He has been promoted to plant superintendent, production control manager, production manager, and most recently to Product Planning Manager, which is a staff catalyst to engineering, manufacturing and sales for new products.

At Rose, he was a member of Lamda Chi Alpha fraternity, where he was house manager, and was responsible for termination of the house activities when it was closed during the war. He was student director of the band, and General Chairman of the Junior Prom.

He is a registered Professional Engineer by the State of Indiana, and in Richmond, he has been active in the Optimist Club and boy's work, a member of the American Legion Band, board member of the World Life and Accident Association, and trustee of the First Friends (Quaker) Church. He is married and has two children.

The increase in sales dollars of more than seven times what it was seven years ago when I started to work for Moto-Mower, Inc. of Richmond, Indiana, a subsidiary of Dura Corporation of Detroit, has made our complete line of lawn and garden equipment one of the most dominating factors in this market today. This tremendous increase is further emphasized by the fact that the sales dollar per unit is considerably less than it was in 1953.

The resulting increase in production and the problems of industrial growing pains have been complex in themselves. In this seasonal business, the final customer, who is our true boss, buys more than seventy-per cent of his total annual expenditure in less than three months. Engineering bills of material for our products have grown in quantity from 15 to over 200, from which one can visualize the effect on manufacturing and recognize that production changes have not been sheer volume alone.

Manufacturing organizations vary in detail by the type of product, overall responsibilities at the location, pressing requirements for emphasis in a given department, and, especially in expanding companies, upon the strength of individuals available to meet the requirements of the tasks to be performed. As Production Manager, my responsibilities included the establishment of production schedules and then maintaining production at an efficient, economical, and high quality level. To accomplish this, the line function which reported to my office were (1) Production Control, (2) General Foreman of Assembly, (3) General Foreman of Fabrication, (4) Superintendent of Second Shift, and (5) Plant Engineering. In order to be effective, it meant working very close with the very important service functions, which were of equal line status, namely, Purchasing, Processing (Methods and Tooling), Personnel, and Cost Accounting. Other functions which are required to complete a successful organization are Product Engineering,

(*Continued on page* 26)

ABSTRACT

VS

CONCRETE

by Jerry Badger
Jr. Math.

"All men by nature have a desire to know."[1] Somewhere back along the line of history, some one, in his search for happiness, decided that he wanted to know more about the physical world around him. That is, he wanted some causual explanation of what went on and the answer to "Why did that happen?" Early attempts to answer the question "Why?" led to ideas such as the many Greek gods.

Back in the period of Greek culture, a man named Pythagoras established a school which carried on even after his death. The Pythagoreans generally resorted to the realm of sensory experience (i.e.—experiment) and the method of induction was sanctioned and utilized. They attempted to interpret nature in light of their findings.

Plato, in his search for ultimate truth about nature, rejected the experimental method with contempt and maintained that truth could only be gotten from thought and that sensory experience could never reveal any truths. He decided that order was better than disorder and that our world was therefore one of order. He sought truths of nature in terms of "simplicity, uniformity, order, and perfection."[2]

A pupil of his, Aristotle, decided that the planets move in circular orbits by the following argument. Aristotle first decided that circular motion is perfect (i.e. — continuous and eternal); and since this motion is perfect, it must be natural to some simple and primary system. The celestial bodies are such a system, and hence they move in circular orbits. Today this argument would merit a laugh. But the experimental school of thought had gone down; and since Aristotle was regarded as an authority, his students accepted this.

The assumptions which Euclid made for his Geometry are called axioms because they were regarded as simple self-evident truths which no one could doubt. But Lobachevski came along about 1840 and questioned this simple self-evident axiom: Given a line and a point not on the line (in a plane), there is one and only one line through the given point parallel to the given line. Euclid assumed one line; so there remained the possibilities of no line or more than one line. A whole geometry has been built on each of these possibilities, and it has been shown that these other geometries are as consistent as Euclidean Geometry. These geometries may not seem practical at first, but fortunately not all people are practical. Later Einstein adapted these to explain his theory of Relativity.

So these simple self-evident axioms may not be a true representation of the physical world after all; a better name would be postulates because a postulate is an assumption and is not regarded as a self-evident truth.

The early exploration in physics was based on the idea that nature had a tendency to simplicity and further that there existed a causual explanation for physical phenomena. This search for knowledge was motivated by a desire to understand the true physical world and was influenced greatly by religious ideas such as "the Supreme Being driving the universe."

Along about the thirteen hundreds a change in thinking came about. "It is futile to employ many principles when it is possible to employ fewer."[3] With this statement William of Ockham asserted that one should avoid unnecessary complications in *describing* nature, but he did not claim that nature had any tendency toward simplicity.

In the fifteen hundreds scholasticism was an accepted means to knowledge. To solve a problem one simply cited the views of scholars or authorities instead of dealing with the problem itself. René Descartes became dissatisfied with this method and in an autobiographical discourse he writes: "I have been nourished

1. Aristotle, *On Man in the Universe*, (New York, 1943). p. 5.

2. Wolfgang Yourgrau and Stanley Mandelstam, *Variational Principles in Dynamics and Quantum Mechanics*, (Pitman, 1955), p. 4.

3. *Ibid.*, p. 6.

on letters since my childhood, and since I was given to believe that by their means a clear and certain knowledge could be obtained of all that is useful in life, I had an extreme desire to acquire instruction. But so soon as I had achieved the entire course of study, at the close of which one is usually received into the ranks of the learned, I entirely changed my opinion. For I found myself embarrassed with so many doubts and errors that it seemed to me that the effort to instruct myself had no effect other than the increasing discovery of my own ignorance. And yet I was studying at one of the most celebrated schools in Europe . . . I learned there all that others learned . . . and I did not feel that I was esteemed inferior to my fellow-students. . . . And this made me take the liberty of judging all others by myself and of coming to the conclusion that there was no learning in the world such as I was formerly led to believe it to be."[4] Descartes realized the need to examine and methodically doubt everything which was considered scientific knowledge. Finally the experimental method made its way back as an acceptable means to knowledge. But it seemed to be difficult for people to shake off old ideas and religious influences, and even men like Kepler and Galileo were under the influence of NeoPlatonic doctrines. Galileo writes: "Philosophy is written in that great book which ever lies before our eyes — I mean the universe — but we can not understand it if we do not first learn the language and grasp the symbols, in which it is written. This book is written in the mathematical language, and the letters are triangles, circles and other geometric figures, without which means it is humanly impossible to comprehend a single word."[5] This shows how anxious he was to *interpret* and *understand* nature.

Sir Francis Bacon summed up the problem which exists in obtaining knowledge: "And the human understanding is like a false mirror, which, receiving rays irregularly, distorts and discolours the nature of things by mingling its own nature with it. . . . The human understanding is of its own nature prone to suppose the existence of more order and regularity in the world than it finds. And though there may be many things in nature which are singular and unmatched, yet it devises for them parallels and conjugates and relatives which do not exist."[6]

In Physics class one is taught (supposedly) the concept of electric and magnetic fields from the standpoint that these things actually *exist;* but the fact remains that such fields are only concepts and exist in the human mind. No one has ever seen an electric field. A student talks about the electricity field intensity (E), but he can not measure it directly. He has to resort to the effects of the field on something he can see for measurements.

One way to measure the electric field intensity is to measure the force due to the field on a unit charge, but this brings up another interesting point. A student is taught Newton's second law: $F=ma$. Now acceleration can be measured. But no one has ever seen a force. Force is only a concept which is useful in describing physical phenomena. Force is a convenience.

Is the concept "force" necessary to describe physical phenomena? The answer is no. For instance Einstein's law of gravitation is simpler than Newton's law of gravitation (in theory). Einstein's law does not require the concept of force.

So human *understanding* of physical phenomena is based on ideas and concepts which are not inherent in the physical entities but are only conveniences for the mind. The ancients who started this search for knowledge were motiviated by a desire to understand nature, and now this desire can not be satisfied.

There are two ways to predict correctly the results of any experiment. The first might be called the engineering approach, i.e.—the try it and see method. First, perform all possible experiments; second, catalog them; third, call this a handbook. Obviously this is not practical.

The second method of predicting results is to have some principle or theory and rules for applying this theory. Of course it would be nice if the number of theories and rules is kept small, for to have one theory for each possible experiment would be no better than the first method. The goal of scientists is to reduce to a minimum the number of theories and rules necessary to completely describe physical phenomena.

The scientist never really knows the things with which he works, but this is of no concern to him because he is interested only in the relation of one thing to another. According to Poincaré, a French mathematician, physicist, and philosopher: "Science is, in other words, a system of relations. It is only in relations that we should attempt to find objectivity; it would be futile to search for it in the things themselves instead of in their relations to one another. The assertion that science can have no objective value because it provides us only with knowledge of the relations would be wrong, for it is just these relations which are to be regarded as objective."[7] In Chemistry class a student is presented the idea of the structure of an atom; this is presented for the student to memorize (no questions asked); but no motivation is ever given. This idea of structure is actually based on the Schrödinger wave equation. However, Schrödinger himself called this idea of structure an "adequate" model rather than a "true model.[8] He did not claim that this is really the way an atom is put together.

At present Schrödinger's wave mechanics seems to be very abstract and for some people very difficult.[9] But when Maxwell introduced his

(*Continued on page* 26)

4. *Encyclopedia Britannica*, 1957 ed., under Descartes, René.
5. Wolfgang Yourgrau and stanley Mandelstam, *Variational Principles in Dynamics and Quantum Mechanics.*, (Pitman, 1955), p. 8.
6. *Ibid.*, p. 10.
7. *Ibid.*, p. 132.
8. *Ibid.*, p. 141
9. As evidenced by the Modern Physics grades.

NEW REACTOR AT SHIPPINGSPORT

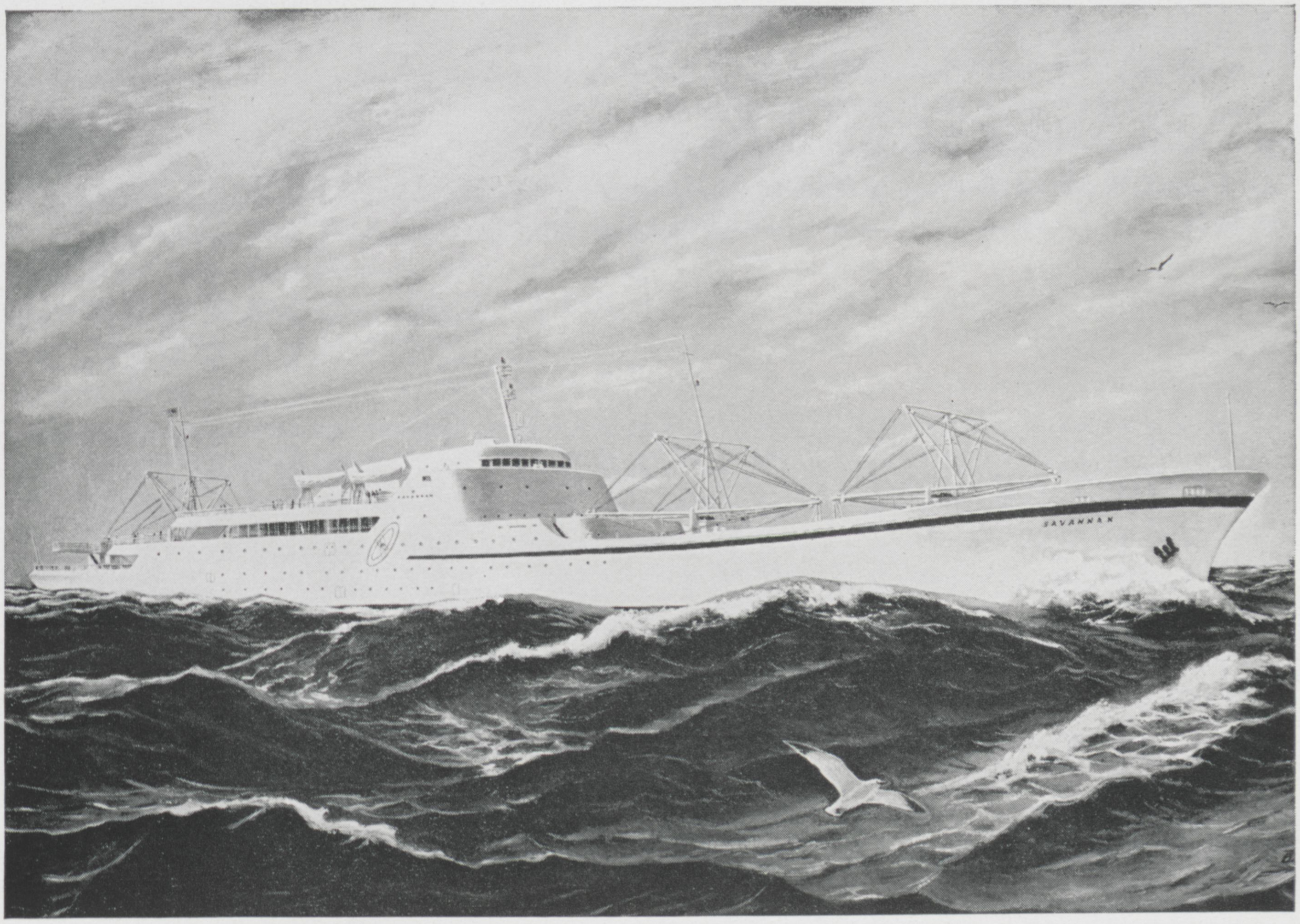
by Dave Morgan,
Freshman

An item of considerable interest to all the world has been the United States first large scale central station atomic power plant at Shippingport, Pennsylvania under the auspices primarily of Westinghouse Electric Corporation, the Atomic Energy Commission, the Naval Reactors Branch, and particularly the Duquesne Light Company. About one third of the light companies in the United States are working with this group, providing money and assistance in exchange for information concerning costs, efficiency, operation, maintenance, and safety. The power plant has been operating commercially since December 1958, experimenting with various shapes of cores as well as core materials. In order to check on efficiencies of various changes in design, the reactor is rigged with a multitude of testing devices that would not be present in a normal commercial installation. Through this added instrumentation, much is being learned about reactor technology that could never be learned from the operation of a laboratory unit operation. The power companies involved with the Shippingport operation send one or two men for three to six months to Shippingport to learn the operation and maintenance of nuclear reactors for power plant operation. In this way, men already in the electrical industry are learning first hand about the operation of nuclear reactors. Thus, instead of only a few men at the installation knowing how to operate a reactor, within a few years, close to two hundred men will have had the opportunity to learn about and perform the actual operation of a reactor.

The Shippingport installation is of the general type known as a Pressurized Water Reactor or PWR. We have all seen the huge installation necessary in conventional power plant for the conversion of tons of coal to steam which is in turn converted to electrical energy. The size of the pressure vessel containing the reactor is only thirty-two feet by nine feet in diameter excluding shielding. The core of the reactor is 6.8 feet in diameter and 6 feet high containing approximately 14 tons of natural uranium and 75 kilogram of Uranium 235. Light water is used as the coolant operating at a pressure of 2000 psi at a temperature of 507.2° F at entry and 538.8 F at the outlet. Light water is also used as the moderator. The coolant is maintained at a point of between 9.5 and 10.5 by the addition of LiOH to prevent excessive loose solid corrosion products. The oxygen content of the coolant is kept below .14 parts per million to prevent the formation of excessive corrision. An excess of Nitrogen is used to keep the oxygen content down since under the operating conditions of the reactor the formation of water is encouraged.

The control rods, made of Hafnium, are 71.5 inches in length and each weigh 55 pounds. The withdrawal rate is 11 inches per minute but the "scram" time is 1.35 seconds. The fuel elements, 145 in number, consist of 32 seed assemblies in a hollow square arrangement and 113 blanket assemblies in the center and outside of the square. The seed contains highly enriched uranium and provides most of the reactivity while the blanket assemblies serve as multiplying reflectors. This particular reactor core is so designed that seed assemblies and blanket assemblies can be interchanged and/or replaced individually. The basic assembly unit of the seed assembly is the fuel plate consisting of an enriched fuel alloy strip between two Zircaloy-2 strips, while the basic structure of the blanket assembly is the fuel rod, consisting of twenty-six fuel pellets

(*Continued on page* 28)



The Nuclear Ship Savannah is capable of sailing 350,000 nautical miles without refueling. Her uranium oxide fuel is packaged in tubes of Nickel Stainless Steel, more than 5,000 of them. In all, engineers specified 200,000 pounds of Nickel Stainless Steel for use in the ship's reactor... to meet the demands of high operating pressures and temperatures, and to provide much-needed strength and corrosion resistance in this critical application.

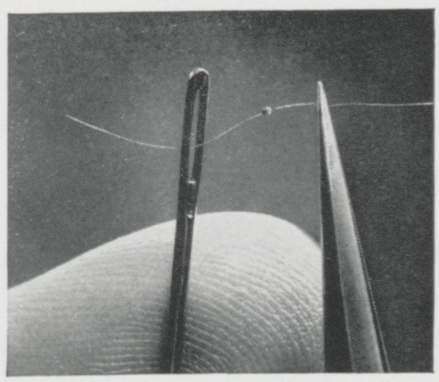
How Inco Nickel helps engineers make new designs possible and practical

When you design equipment, you'll have to select materials to meet given service conditions – materials that might have to resist corrosion, wear, high temperatures, or fatigue. Over the years, Inco has developed new alloys and gathered information on the performance of materials under these and many other service conditions. Inco will be glad to put this data at your disposal to help solve your future metal problems.

Inco's List "A" contains descriptions of 200 Inco publications which are available to you, covering applications and properties of Nickel and its alloys. For List "A", write Educational Services.

The International Nickel Company, Inc.
New York 5, N. Y.

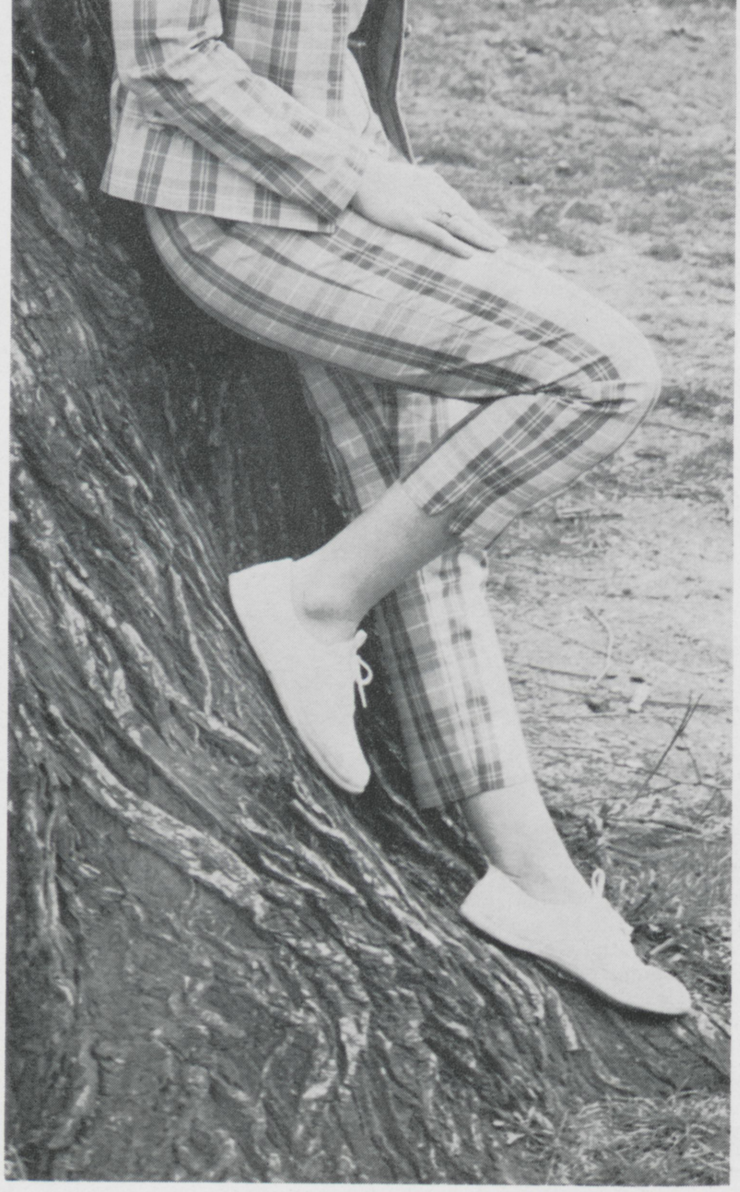
New push-button roof of Nickel Stainless Steel turns a weatherproof auditorium into an open-air stadium in a matter of seconds. The dome will provide years of carefree beauty. That's because stainless steel with Nickel in it is one of the most durable of metals. It's corrosion-resisting all the way through.



Needle's eye reveals relative size of a Thermistor, a tiny bead made with Nickel oxide—used to measure temperatures in and beyond the earth's atmosphere. The Nickel oxide helps develop electrical properties for the accurate recording of temperature changes as small as 1/50th of a degree!

INCO INTERNATIONAL NICKEL

The International Nickel Company, Inc., is the U.S. affiliate of The International Nickel Company of Canada, Limited (Inco-Canada) —producer of Inco Nickel, Copper, Cobalt, Iron Ore, Tellurium, Selenium, Sulfur and Platinum, Palladium and Other Precious Metals.



MISS TECHNIC OF APRIL

The gal on the pages of this month's *Technic* is 18-year-old Rita Ann Toney from Merengo, Indiana. Rita is a Freshman at ISC majoring in elementary education and minoring in math . . . and why not with her access to such figures as $(3.2711)^3$ - $e^{3.17805}$ - antilog 1.56820 and mass 3.8 slugs. Being a member of Alpha Omicron Pi sorority is an important but not the only one of Rita's social activities. The Association for Childhood Education occupies part of her time—ah, to be a child again. Rita sings with the Choral Union and also is an ardent supporter of the Pep Club.

Dark brown eyes and dark brown hair naturally lend themselves to Rita's yen for the outdoors. Our photographer found Rita enjoying the sunny spring weather.

PROJECT PLOWSHARE

By Ken Miller, Soph., e.e.

Usually thought of only in terms of their destructive capabilities, nuclear explosions are now finding important peacetime applications. Three years of underground nuclear blasting conducted under Project Plowshare have demonstrated certain advantages in using atomic explosives, rather than conventional explosives, as a source of heat and explosive energy. Nevertheless, utmost caution must be observed because of radiation and seismic effects of nuclear detonations.

Plowshare has included a study of the consequences of varying the depth and charge of a subterranean nuclear firing. Taking into account both relative intensity and distance beneath the surface, the "scaled depth" measurement is determined by dividing the depth of the explosion in feet by the cube root of the yield in kilotons. An atomic burst with a scaled depth under twenty feet pulverizes the excavated earth and blows it completely from the crater produced. A blast of scaled depth sixty-five feet forms an open crater and crushes tons of rock below sixty-five feet. Craters of maximum volume are sculptured with explosions of scaled depth 150 feet. Beyond a scaled depth of 300 feet, no open crater results, but only an underground cavity surrounded by crushed rock.

In one unique discharge of scaled depth 670 feet, the cavity coated itself with four inches of melted rock. Within seconds, a four-hundred foot column of crushed rock had accumulated atop the explosion cavity. This 1:7 kiloton device mashed approximately 500,000 tons of rock and created nearly 200,000 tons of permeable rock, yielding 300,000 and 120,000 tons of rock per kiloton respectively. By means of holes bored deep into the depression, it was estimated that 3,000,000 Btu of energy was available at temperatures exceeding 400° F. Eighteen months later, the highest temperature was still 194° F.

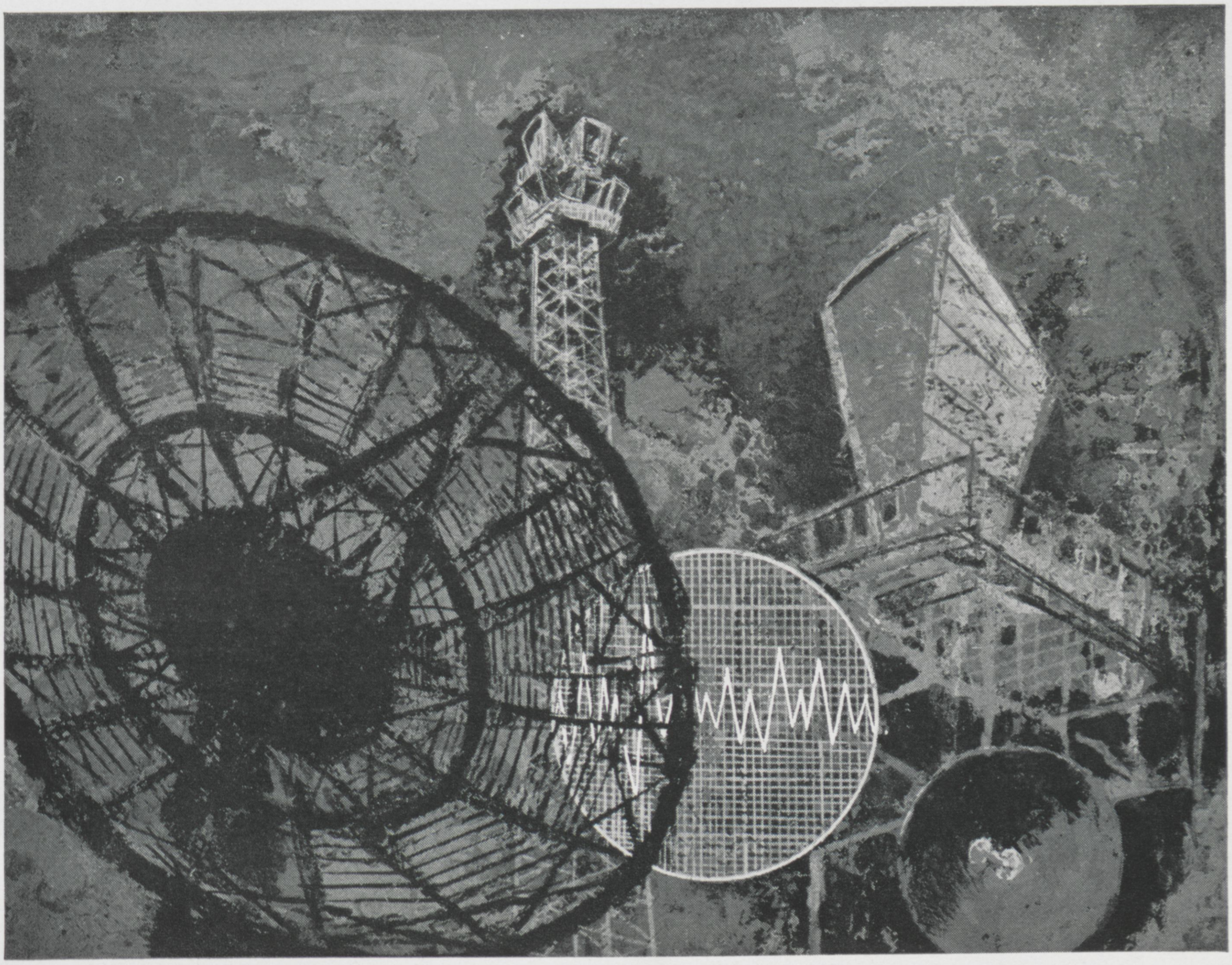
Project Plowshare also contains an investigation of the pros and cons of nuclear versus conventional explosives. In general, nuclear discharges release greater amounts of energy, occur much more rapidly, and emit radioactivity. Yet, how economical is a nuclear explosion in generating heat and detonating power, as compared to a chemical explosion?

Generally, heat from small atomic bursts is fifty to one-hundred times more expensive than from conventional firings. Large nuclear charges in the order of one megaton still are twice as expensive sources of heat as coal or natural gas. However, the cost of heat from fission of uranium is below that from nuclear explosions. In all probability, then, nuclear reactors will remain a more efficient source of heat than uncontrolled nuclear exposions.

On the other hand, atomic blasts do provide an excellent source of explosive work in moving huge quantities of earth and rock. Possessing a firepower equivalent to anything from fifty to several million tons of conventional explosives, nuclear charges have the added advantage of being compact. They may be easily positioned for detonation within the earth. Although nuclear explosives are not particularly efficient as a source of heat, they are very practical in explosive yield. Even though the cheapest type of chemical charge is three times more expensive than the most costly nuclear device, nuclear explosives are less efficient than their chemical counterparts. The conventional charge will excavate two million cubic yards per kiloton; whereas, an atomic explosive rarely exceeds 300,000 cubic yards per kiloton. As a result, limited nuclear bursts are more costly than conventional firings per cubic yard excavated. Notwithstanding, nuclear devices become more appropiate and economical for enormous detonations.

Is radiation a great danger in subterranean atomic blasts? Admitedly, firings near ground level pour all their radiation into the air, but as the depth of the explosion increases, more radiation is absorbed by the rock strata and less escapes into the atmosphere. Finally, a depth is reached where there is little or no surface radiation. The problem of

(*Continued on page* 29)



Is your future up in the air?

As the communications needs of our nation become steadily greater and more complex, the Bell Telephone System is continuing its pioneer work in microwave by "taking to the air" more and more to get the word across.

To this end, Western Electric — the manufacturing arm of the Bell System — has the monumental task of producing a large part of the microwave transmission equipment that knits our country together by shrinking thousands of miles into mere seconds.

In spite of its great technological strides, the science of radio relay is a rapidly-changing one. And new breakthroughs and advances are common occurrences. A case in point: our Bell System "TH" Microwave Radio Relay. This newest development in long-distance telephone transmission will eventually triple the present message-carrying capacity of existing long-haul radio relay installations. A full-scale system of 6 working and 2 protection channels can handle 11,000 telephone messages at the same time.

To make microwave work takes a host of special equipment and components: relay towers, antennae, waveguides, traveling wavetubes, transistors, etc. But just as important, it takes top-caliber *people* to help us broaden our horizons into such exciting new areas as communication by satellites!

And microwave is only part of Western Electric's opportunity story. We have—right now—hundreds of challenging and rewarding positions in virtually all areas of telephony, as well as in development and building of defense communications and missile guidance systems for the Government.

So, if your future is "up in the air," you owe it to your career to see "what's up" for you at Western Electric.

Opportunities exist for electrical, mechanical, industrial, civil and chemical engineers, as well as physical science, liberal arts, and business majors. For more information, get your copy of "Western Electric and Your Career" from your Placement Officer. Or write College Relations, Room 6105, Western Electric Company, 195 Broadway, New York 7, N. Y. And be sure to arrange for a Western Electric interview when the Bell System recruiting team visits your campus.

Western Electric

MANUFACTURING AND SUPPLY UNIT OF THE BELL SYSTEM

Principal manufacturing locations at Chicago, Ill.; Kearny, N. J.; Baltimore, Md.; Indianapolis, Ind.; Allentown and Laureldale, Pa.; Winston-Salem, N. C.; Buffalo, N. Y.; North Andover, Mass.; Omaha, Neb.; Kansas City, Mo.; Columbus, Ohio; Oklahoma City, Okla. Engineering Research Center, Princeton, N. J. Teletype Corporation, Skokie, Ill., and Little Rock, Ark. Also Western Electric distribution centers in 33 cities and installation headquarters in 16 cities. General headquarters: 195 Broadway, New York 7, N. Y.

MECHANICAL TEACHERS

by Bob Valle,
Freshman

Bob Valle Tells of the advance of the Teaching Machine and its proposed use at Rose next year . . . . .

Since the beginning of the Industrial Revolution in the late eighteenth century, the path of science and scientific advancement has been second to none in the eyes of even conservatively progressive people. Transportation has advanced from horseback to horse and buggy, horseless-carriage, modern automobile, and airplane, and now we are on the threshold of interplanetary space travel. Each step was reluctantly accepted as the early twentieth century dodged the wild machine of Henry Ford only to be challenged from above by the Wright brothers. But with necessary revisions and improvements, the modern modes of travel are accepted by the modern society.

Medicine has seen great advances in the past two centuries as once dreaded diseases such as smallpox, typhoid fever, yellow fever, malaria, and polio have been made controllable. Psychology, although yet a new science, is seeing in many circles the case where its specialist, the psychologist, is often consulted with problems that one's minister cared for not long ago.

Science and its applications have seen in the past two centuries a rapid success shared by few institutions. For as long as people have striven to live peacefully together there has been an insoluble problem of the better type of government. For just as long a time people have held tenaciously to the practice of religion in one of over five-hundred sects. Yet the exclusion of one of these sects is considered by many an attack upon one's natural inalienable rights. Although these examples contain an element of choice or preference and therefore possibly are subject to a study of metaphysics, nevertheless it illustrates that science alone is accepted as almost indisputable by a so-called "modern" society.

Education, which has existed probably, in one form or another, as long as religion and even longer than organized government has only been the object of a shy smattering of technological advancement. The crime of the matter is that modern technology, which is supposedly so vitally interested in the future, has not made its contribution to the education which provides for advancement. One interested observer said that "it is the obligation of individuals who are engaged in engineering to apply themselves to help the process of education." Simon Ramo, a distinguished electronics engineer and designer of missiles had this to say: "This rapid and potentially dislocating scientific advance can be expected to heighten the coming crisis in education. Already, the increasingly technical world uses more scientists and engineers, yet the very industrial development that is part of the growing technical society takes the engineers and scientists away from the university and high-school facilities, and the fast world in which we live makes the long study of science seem unattractive to the youngsters. The technical society is complex, rapid, and increasingly dangerous. We can blow up the world, yet such a premium is put on the use of our human and physical resources for everything but education that it seems that the new technical society is going to be accompanied by a weakened ability to keep pace education-wise."

THE HISTORY

In 1926 Doctor Sydney L. Pressey, a psychologist at The Ohio State University released a paper announcing the development of an "examination machine." It was the belief of Dr. Pressey that much of a teacher's time was spent in unnecessary clerical work rather than in the development, education, and formation of the students. Further, he believed that this "wasted" time brought about a lack of enthusiasm on the part of the student and the teacher. With the principle that machine testing would not degenerate the effect of testing but would allow the teacher to strike much needed enthusiasm into the educational society, Dr. Pressey set out to develop a machine to do a more efficient job of a particular type "just as a calculating machine is more accurate than the old-time bank clerk." As he developed this machine, Pressey realized that "the procedures in mastery of drill and informative material were in many instances simple and definite enough to permit handling of much routine teaching by mechanical means." Despite Pressey's work in this field, education was not ready for the technological advances which were surrounding it at the time.

Within the last few years, the idea of teaching machines has begun to pervade the educational circles with success. Much of the success is due to the work of the eminent Harvard psychologist, B. F. Skinner. By applying some techniques he proposed for his version of the teaching machine, Skinner developed pigeons into ping-pong players. He rewarded the pigeons after each successful movement, a practice which is educationally essential to thorough learning according to Skinner. It is due to this principle of reward or reinforcement that Skinner suggests that teaching machines would be a valuable aid to the teacher, and around this principle that he designed his "machine."

THE MACHINE

Despite great variation in complexity and special features, all of the devices that are currently called "teaching machines" represent some form of variation on what can be called the tutorial or Socratic method of teaching. That is, they present the individual student with programs of questions and answers, problems to be solved, or exercises to be performed. In addition, however, they always provide some type of automatic feedback or correction to the student so that he is immediately informed of his progress at each step and given a basis for correcting his errors. They, thus, differ from films, TV, and most other audio-visual media as ordinarily utilized because of three important properties.

First, continuous active student response holds the student's interest, gives him constant practice, and checks his progress in the subject.

Second, a basis is provided for informing the student with minimal delay whether each response is correct, leading him directly or indirectly to correction of his errors.

Third, the student proceeds on an individual basis—the faster student rapidly covering the prescribed program whereas the slower student may cover the material at his own rate while the machine displays indefinite patience.

THE EXPERIMENT

The idea of "teaching machines" and new methods of technological education has reached the Rose Polytechnic Institute campus, and plans currently call for September installation of one of the varied forms of the machine. Since teaching machines have been applied mainly to definition facets of subjects such as chemistry and physics or pure word-answer questions from a course in psychology or history, Professor A. R. Schmidt of the Mathematics Department of Rose Polytechnic spent last summer studying the possibility of applying teaching machines to the Rose curriculum and more specifically to a mathematics course. As a result, it is planned that next year's freshman class will be first instituted into this program on a purely experimental basis.

The class will be divided man for man as nearly as possible according to background, environment, ability, and potential. One group will use the teaching machines and the other group will not. This program, of course, will only be a part of the mathematics course. At varied intervals throughout the first two years of the program, various data will be compiled to attempt to analyze the value of the teaching machine. It is also planned to test the machine as a purely background instrument by taking some people off the program after a certain time. Many other possibilities will also be tested by manipulating the personnel involved.

The machine to be used will be

(*Continued on page* 27)

From Newton

Probably the most well known law to all students of electrical engineering is the fundamental law of Ohm, $V = IR$. Usually, in a beginning course, one obtains some notion of the voltage or potential as the electrical pressure or force which sets up a current flow of electrons, as water pressure forces water to flow through a pipe. Very seldom, however, does one obtain much of an idea about the other quantity, resistance. After all, a conductor and a resistor are basically the same thing, so why should they act so different? Let's imagine ourselves deep inside of a material and see what is going on.

We will consider Ohm's law in the "point" form

$$E = J\rho \,, \qquad (1)$$

where E = electric field (volts/meter), J = current density (amperes/meters²), and ρ = resistivity of the material. We will also refer to δ, the conductivity, where

$$\delta = 1/\rho.$$

Deep inside of the material, we see electrons whizzing around in the material as a result of an applied electric field. If we apply Newton's Law

$$F = ma,$$

it becomes

$$-eE = m\frac{dv}{dt}, \qquad (2)$$

or if we assume the field is a D.C. field (time-independent),

$$v = -\frac{e}{m} Et, \qquad (3)$$

where v = velocity of the electron, e = electronic charge = 1.6×10^{-19} coulombs, m = mass of the electron, and t is time. Since the current density is $J = \eta v$, where η is the charge density, we may express

$$J = -nev, \qquad (4)$$

where n = number of electrons per unit volume, since the charge density is merely $\eta = -ne$. Substituting the velocity derived above, we obtain

$$J = \frac{+ne2}{m} E\text{-}t. \qquad (5)$$

We would like to call the quantity in brackets the conductivity, but we obviously have an incorrect answer, for we know that Ohm's Law states that for a constant applied field, the current is also constant and does not increase with time, as our equation seems to indicate. So, back to the drawing boards . . .

In order for the current to be constant with time for a constant applied field, the average velocity of the particles must also be constant, thus in addition to the acceleration provided by the electric field, an acceleration due to something else must be present such that

$$\left(\frac{\partial v}{\partial t}\right)_{field} + \left(\frac{\partial v}{\partial t}\right)_{other} = 0 \qquad (6)$$

where from (2)

$$\left(\frac{\partial v}{\partial t}\right)_{field} = -\frac{e}{m} E \qquad (7)$$

Let us look closer at the electrons as they move. They go whizzing past us for use, but in the space around us lie enormous nuclei, and occasionally the electrons collide with these. Some experience several collisions as they travel through, and some seem to go by without any at all, passing in between the nuclei in their lattice like crystalline arrangement. Each electron has a different velocity. Let us suppose that we average all of the velocities of the electrons, and we find the average velocity due to collisions only to vary with time as a simplified exponential, thus

$$\bar{v}(t) = \bar{v}_0 e^{-t/\tau} \qquad (8)$$

where γ is the average time between collisions (sometimes called the relaxation time), and the bar above v indicates the average value of v.

$$-\frac{e}{m}E - \frac{v_0}{\tau} e^{-t/\tau} = -\frac{e}{m}E - \frac{\bar{v}(t)}{\tau} = 0 \qquad (9)$$

Thus $\qquad \bar{v}(t) = -\left(\frac{e\tau}{m}\right)E$

The velocity of the electron per unit of field strength, $-\frac{eJ}{m}$ in this case, is often referred to as the electron mobility.

$$J = -nev(t) = \left(\frac{ne^2\tau}{m}\right)E \qquad (10)$$

Since all the factors preceding E are constants, the above equation is merely Ohm's Law with

$$\rho = \frac{m}{ne^2\tau} \qquad (11)$$

Sometimes the average number of collisions per second, μ, is used in place of the relaxation time, ζ. If the average time between collisions is ζ, then the average number of collisions per second is

$$\gamma = \frac{1}{\tau} \qquad (12)$$

γ is also commonly called the collision frequency. Thus we see that the resistivity is primarily depend-

To Ohm*

by Dr. Charles C. Rogers
Electrical Engineering Dept.

**The development here follows that of A. J. Dekker, "Electrical Engineering Materials," Prentice-Hall, 1959. Other more complete analysis may be found in texts on solid-state physics.*

ent upon the number of collisions the electrons have with the lattice nuclei. More collisions imply a higher resistivity to the flow of the electrons through the crystalline structure.

The above analysis is sometimes referred to as the derivation of Ohm's Law from Newton's Law, $F = ma$.

It is now also easily seen how electrical resistance produces heat from the foregoing description. The temperature of a material is primarily a measure of the random vibrational energy of the nuclei comprising the crystal. The faster the nuclei vibrate, the hotter the material is. If enough energy is added to the nuclei so that they vibrate so fast as to break the crystalline bonds, the material melts and becomes a liquid. In fact, temperature, T, may be defined by the equation

$$Nmv^2 = kT \qquad (13)$$

where N = number of nuclei per unit volume, m = mass of a nucleus, and v^2 is its mean-square velocity. k is a proportionately constant which occurs throughout physics and is known as Boltzmann's constant. Thus, as the electrons collide with the nuclei, they give up their energy to the nuclei, causing them to vibrate faster, and thus the temperature rises and heat is developed.

Let us assume a simplified model, which will nevertheless give very meaningful results. We shall assume that when the electron collides, it transfers all of its energy to the nucleus and is completely stopped. It then begins to accelerate again in the aplied field. At some time t before the electron has collided, it will have a velocity

$$v(t) = -\frac{e}{m}Et \qquad (14)$$

After this time, it will have gained an energy

$$(\Delta W)_t = \frac{1}{2}mv^2 = \frac{1}{2}m\left(\frac{e}{m}Et\right)^2 = \frac{e^2E^2t^2}{2m} \qquad (15)$$

Now all the electrons will not last out this time. Some will last longer, some less. Let us assume that the probability or likelihood of an electron lasting a time t without a collision is e^{-t}/ζ. Thus if we start with n electrons, there are ne^{-t}/ζ electrons left after time t that have not yet had a collision. If there are $1/\zeta$ collisions per second, the likelihood of an electron colliding in time $\triangle t$ is $\triangle t/\zeta$.

Thus if there are ne^{-t}/ζ electrons at time t, the product
gives us the probability that these electrons will collide in the coming $\triangle t$, which is the time between t and $t + \triangle t$. Thus, the average energy increase per unit volume per collision is

$$\Delta W = \int_{t=0}^{\infty} (\Delta W)_t\, n e^{-t/\tau} \frac{dt}{\tau} = \frac{ne^2E^2}{2m\tau}\int_{t=0}^{\infty} t^2 e^{-t/\tau}\, dt \qquad (16)$$

Performing the integration,

$$\triangle W = n\zeta^2 e^2 E^2/m. \qquad (17)$$

The total energy transfer per second (or power) is thus

$$P = \frac{\Delta W}{\tau} = \frac{Ne^2\tau}{m}E^2 \qquad (18)$$

Thus, from (9), this is merely

$$P = \frac{E^2}{\rho} \qquad (19)$$

an expression familiar to all of us in the macroscopic form $P = \frac{V^2}{R}$

This represents the Joule heat produced in the material.

These results, although somewhat simplified, present the true picture that resistivity is a measure of the collisions that the electron encounters. Actually, within a material, the electron and nuclei almost never come into direct physical contact, and the collision is an encounter in which the path of the electron is appreciably altered. If the electrons of a material have an infinite collision frequency, they do not move at all, and behave as if each one were tied to a particular nucleus. Thus, if we desire a good insulator, we choose a material whose atoms have "full" electron shells. On the other hand, conductors have free electrons which are not bound to any particular atom and readily move about in the material with very few collisions.

Resistivity, then, is the result of electrons colliding with the nuclei or atoms which comprise the crystal lattice. When an electron collides with the lattice and transfers its energy to the nucleus, its vibrational energy increases. The temperature is a direct measure of this vibrational energy, and thus the current flow through a resistive material raises its temperature, producing heat.

Library Notes

By Carson Bennett and Winifred Kitaoka

Each of us must find our own 15-minute period each day (for reading). It is better if it is regular . . . The only requirement is the will to read. With it you can find the 15 minutes no matter how busy the day . . . That means you will read half a book a week, two books a month, 20 a year, and 1,000 or more in a reading lifetime. It's an easy way to become well read.

Louis Shores

Very often when checking a book out, we note with dismay how rarely a book is circulated, by the number of signatures that appear on the book card. However, we never realize, there have been books circulated often, and many having required a second card. Through the years we have kept the book cards that have been filled and this is what we found the count to be:

Books	45
Records	37
Periodicals	6

Each card takes about 26 circulations to complete, so quite obviously, our record collection has been quite popular, and has attracted many students and members of the faculty.

We have been receiving many new journals and are expecting more new ones. We have a complete listing of our journals in the February Newsletter. You are welcome to copies found in the Library.

These are other new journals not found on that list:

Journal of Industrial Engineering
Indiana Magazine of History
Kybernetik
Mississippi Valley Historical Review
Solid State Abstracts

Spring is in the air and with it our thoughts turn to outdoor sports. We, of the library, looked through our collection and have these titles to suggest if you're a Sports Enthusiast:

Encyclopedia of Sports,
by Frank G. Menke

A source of information to the millions who have enabled the sports field to achieve the heights it has. In this volume is contained clear, factual history of each sport.

The Greatest Sport Stories;
from the New York Times

Edited by Allison Danzig and Peter Brandwein

From the files of the *New York Times* have been selected accounts of the most celebrated events in the field of sports dating from the first year of publication of the *Times.*

General Baseball Doubleday,
by Robert S. Holzman

This is the story of the Civil War General who invented baseball and of the development of the game up to the present.

The Fireside Book of Baseball,
edited by Charles Einstein

A collection of stories, articles, poems, letters, reminiscinces and reports of games.

Sports in American Life
by Frederick Cozens and Florence Sumpf

This book has been written for all persons interested in games, sports, and recreational activities.

Ford Treasury of the Outdoors

Here are notes on trout fishing and clam-digging — to hunting with a crossbow-

Of Men and Cars,
by John Christy

This takes you into a new world of speed, courage, and daring — and into the world of record breakers.

The Sports Car,
by Colin Campbell

Mr. Campbell treats the design and performance of this fascinating vehicle — the *Sports Car.*

Gentlemen, Start Your Engines,
by Wilbur Shaw

An amazing human revelation of a vivid personality adventuring in one of the most stirring occupations known to man.

For thirty-five years Wilbur Shaw had sought speed and danger, and found both. He won the Indianapolis 500-mile classic three times, a feat only two drivers since 1911 have equalled. However, Shaw is the only

(*Continued on page* 30)

Fraternity Notes

SIGMA NU

To the relief of many who read this column, next month's news will not be written in this reporter's own inimitable style, for elections will be held April 11 and a new reporter, with exciting new ideas, will spout forth with goodly news. Please bear with me one more time.

April 7 was the date for a mixer with the Sigma-Kappa's featuring a Hawaiian theme. A prize was given for the best "Lei" of the party.

Division Conference will be held at Epsilon Mu (Butler) April 23.

Our pledges are busy scheming up ways to raise money for their pledge dance. If they do as well as last year's group, and we're all sure they will, the dance will be a huge success.

Steve O'Neil and Max Hinshaw are out for baseball again this year, adding mightely to the team.

Yours truly has started song practice now, which means that the total weight of the chapter will decrease, due to many missed lunches. We're doing a Russian song, (in English no less) called "Meadowlands", "Cavalry of the Steepes", or "Song of the Plains". Our fraternity song is going to be a secret, so don't tell anyone what it's going to be.

We're in the process of more or less planning to move to the campus in the future. That is, we are preparing a proposed yearly budget for living in a new house on campus. We recognize that we will need a new house or an annex in the future, but whether or not to move to the campus, with all of its many advantages, is the point in question. We will need to get more facts from the administration such as whether or not they can force us to move, before we decide.

Oh yes, we received a letter from Dick Light ('58) informing us that he'd been promoted to sales engineer for E. W. Bliss Co. L. Peter wanted to know where Dan Maffucci and Jack Gaughn are. Dick writes that he is still president of the Bachelor's Protective Association.

Bob Carter

ALPHA TAU OMEGA

Alpha Tau Omega proudly announces its newly elected officers for the following year:

Worthy Master (President), T. C. Copeland;
Worthy Chaplin (Vice-President), Vern Fellows;
Worthy Keeper of Exchequer (Treasurer), Dale Oexmann;
Worthy Keeper of Annals (Historian), Rick Rapson;
Worthy Scribe (Secretary), Al Jannasch;
Worthy Usher, John Walden;
Worthy Sentinel, Fred Wright;
Fiscal Assistant, Nick Kira; Pledge Trainer, Dick Cordill.

These men have a big job ahead of them in continuing the fine job their predecessors have done. The active chapter wishes to congratulate and thank the retiring officers for their fine work for the chapter and the fraternity.

ATO is proud to announce that two of its members were honored at the Spring Honors Assembly. Brother Al Hannasch was tapped for Blue Key National Fraternity, and Brother John Walden was tapped for membership in Tau Beta Pi. Good work Al and John.

This year's pledge class is not to be outdone in its sabotage feat. At about 3:00 A.M. one morning the pledge class invaded the chapter house and borrowed a few sections pipe from the rest room, leaving the said room useless to the chapter. Needless to say, retaliation by the actives was not far away.

Socially the Taus enjoyed a very nice house party preceeding the St. Pats Dance, with a good time had by all. The Taus also recently enjoyed trade parties with the Delta Gamma sorority on April seventh and the Chi Omegas on April fourteenth.

New appointments in Alpha Tau Omega include: Rush Chairman, Jack Munro; House Managers, Dave Starnes and Andy Breece; Song Director, Larry Schaffer; Athletic Director, Bill Volkers; Technic Reporter, Jon Modesitt; Tau Editor, Joe Snyder; Gregg Mitton, Palm Reporter; Social Chairmen, Tom Bosworth and Lowell Shepler; Scholarship Chairman, Brent Robertson;

(*Continued on page* 29)

OBS. OF SUCCESS

(*Continued from page* 11)

Research and Development, Sales and Service, and Controller and Finance, all of which are outside of the manufacturing group, but must work together in close harmony.

Success of any supervisor, whether a foreman of ten workers, or the president of the Company, is dependent upon the people working with him. I know of no one-man jobs which exist in industry today. As the desires and needs of individuals become more and more recognized by progressive management of today, there becomes less and less of a place for the hardheaded, dogmatic titan who was so successful and characteristic thirty years ago. The "bull of the woods" type supervisor who has been so aptly personified by the cartoons of the late Garr Williams, is as out of place in modern industry as the mine-shaft powered production equipment depicted with him. This does not mean that you as potential leaders should not form your own convictions and stick by them, or that you should compromise your principals or integrity, or should not fight for what you feel is the best solution to your company for any problem. Far from it. Strength of character, convictions, and integrity, are more important today than ever; moreover, your success today depends upon your ability to work with people and upon your ability to instill your convictions and objectives so they may creatively expand your efforts to make these mutual objectives a reality. This becomes a challenge to make your objectives and thinking clear, concise, and understandable to others in a manner which obtains the enthusiastic cooperation of your associates.

Graduation with a technical degree will indicate the completion of the best training possible within the limited time available. Attack to a technical problem will be swift and accurate to a precise "black or white" conclusion. For other than technical problems, you will rely more strongly upon judgment as to the approach, selection of several methods for solution in order to arrive at the best possible conclusion, which will possibly be "grey . . . not black or white". My most important message from college came from a professor of mathematics teaching calculus. This message can be found in the two, very simple, provocative questions—"Why?" and "Is it reasonable?" "Why?" when any project is in process, and when concluded "Is it reasonable?" These questions must still be raised and answered—sometimes audibly, sometimes only thought processes, but always raised and answered—before a sound conclusion can be finalized.

It is only in retrospect that I realized that the staff and management at college hold their esteemed positions, not only by their knowledge and their ability to pass some of it on to the students, but also by their skill in the humanities of leadership in their joint project of your future. You may be able to benefit by this realization now.

ABSTRACT VS. CONCRETE

(*Continued from page* 13)

ideas in 1865, they were also regarded as abstract and difficult; even twenty years later few physicists had caught onto the meaning of Maxwell's theory. Now not only physicists but also electrical engineers use Maxwell's theory and are not bothered by its abstractness.[10]

Once a student realizes that he can never really *understand* nature, he can concentrate on understanding the applications of theories and principles. One thing essential to this understanding is an understanding of the mathematics involved.

The physicist never really knows what he is doing. He starts with the effects and then works backward to find a cause. He seeks a simple model, and so he assumes something and then sees where it leads him. If this assumption does a good job of describing things, then he tries it on another similar problem. The engineer would now, by the method of Engineering Induction,[11] call this a theory. However, the physicist would try this idea on a few more problems and then call it a theory.

Since engineering is the practical application of physics and since the physicist does not know what he is doing, it follows that the engineer can not possibly know what he is doing (but he is proud of his answers anyway).[12]

The pure mathematician alone knows what he is doing. He calls the objects of his study *elements,* and he explicitly states the relations between these elements and a set of formal postulates (assumptions). These postulates tell the mathematician explicitly what he is doing. But the mathematician does not know what he is talking about.[13] That is he does not know what specific physical entities his elements represent. This last statement is the real beauty of mathematics. The mathematician does not rely on any physical properties of the elements because the elements are abstract things and have no physical properties. He proceeds to prove theorems about these elements based only on the properties explicitly stated in the postulates. If some one now comes along with some physical entities and the relations between these entities satisfy the postulates, then the mathematician already knows some theorems about the physical entities.

The value of mathematics as a tool for science is based on the fact that mathematics is abstract and can be applied to anything. Maxwell's theory and quantum mechanics are two examples of the value of mathematics in science and engineering. The farther man probes into nature, the more the need for abstraction. Mathematics is the key to the future.

10. It must be remembered that if an engineer can get an answer, he does not worry.

11. Engineering Induction.
First, take two measurements. Second, plot these on a graph of whatever was measured versus something else. Third, draw a line through these two points. Fourth, call this a theory.

12. If the reader is an engineer, he is permitted a laugh at this point.

13. Engineers will please refrain from laughing.

MECHANICAL TEACHERS

(*Continued from page 21*)

about the size of a portable record player. It will have two openings on its face. On the left the program, composed of questions covering a subject in very short steps, will appear and on the lower right a place for the student to write his answer. Then with the twist of a dial the correct answer appears while the written answer slides under a glass covering for comparison.

It must be understood that the only difference between the two divided groups in this experiment will be in the use of the teaching machine: class hours will be the same and lectures will be taken in a mixed group. In the event that teaching machines should become a part of the curriculum, teacher-contact hours would not decrease but rather certain advantages of the teaching machine should make these hours more beneficial.

The advantages of the teaching machines from analysis of previous tests seem to indicate that education will begin to emerge again into the modern era. The machine induces a constant interchange between program and student due to constant student activity. A student may not pass over a point until it is understood whereas the lecture, audio visual aids, or textbooks allow the student to pass over a topic lightly. Conversely, the program requires the student to go only as fast as he is capable without moving on until the student is prepared. Similar to a private tutor, the machine gives the student an immediate feeling of accomplishment upon getting the correct answer. This eliminates one flaw in the present method of testing since it has been found that a test returned after twenty-four hours is only about half as valuable as immediate return and any time after two days renders the returning of the test nearly useless. The machine also will allow the student to come to class with some definite idea of his areas of difficulty. Also, due to the step-by-step method of presentation the teaching machine will teach the student to read carefully and closely.

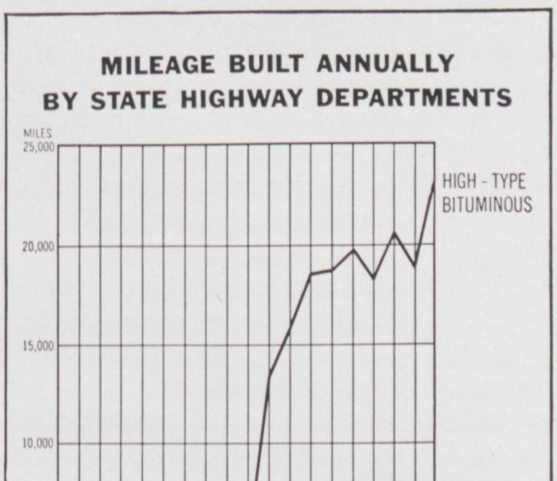
THE KEY

Necessarily, the one element which must be efficient in order to insure the success of machine teaching is a good program. Just as a good textbook should be judged by the way the material is presented, a good program must convey the idea of each topic in an easily-understood manner. Machine programs have the advantage of being easily modified whereas the textbook cannot be easily rewritten.

Many opponents to the idea of machine teaching contend that macines cannot possibly replace "human" teachers. It is not, however, the purpose of teaching machines to replace teachers, or textbooks, or lectures, or teacher-contact hours but only to supplement these facets of education in an advantageous way. For as Programmer Komoski put it: "Any teacher who can be replaced by a machine deserves to be replaced."

Why America's state highway engineers give first choice to Modern High-Type Asphalt Pavement:

The graph on the left shows you that in 1958 *alone* the use of high-type Asphalt pavement increased *618%* over 1940. This is because advances in engineering know-how, in Asphalt technology and in the development of the mechanical paver have made modern, high-type Asphalt pavement the first choice of highway engineers. Its more economical construction and low maintenance costs have saved many millions of tax dollars and kept America's wheels rolling.



SOURCE: U.S. Bureau of Public Roads

Recent engineering advances have developed new, DEEP STRENGTH Asphalt pavement which will provide even better performance and greater pavement economy in the future.

The tax savings possible will amount to millions of dollars and will mean more and better local and interstate roads for our nation.

Your future success in civil engineering can depend on your knowledge of modern asphalt technology and construction. Send for your free "Student Kit" about Asphalt technology. Prepare for *your* future now!

Ribbons of velvet smoothness . . .
ASPHALT-paved Interstate Highways

DEEP STRENGTH ASPHALT PAVEMENT

THE ASPHALT INSTITUTE
Asphalt Institute Building, College Park, Maryland

Gentlemen: Please send me your free student portfolio on Asphalt Technology and Construction.

NAME__________ CLASS__________
ADDRESS__________
CITY__________ STATE__________
SCHOOL__________

Experience

is a great teacher

but . . .

you can learn more

from books

cheaper and faster

Order your books through

Rose Polytechnic Book Store

NEW REACTOR AT SHIPPINGSPORT

(*Continued from page* 14)

in a 9½ in. long Zircaloy-2 tube. The pellets are cylinders of Uranium dioxide. Coolant flows through every part of the assemblies by means of spaced holes in the plates and tubes. A vital part of the instrumentation in the core are provisions for coolant temperature, seed fuel plate temperature, failed element detection and location (FEDAL) and flow measurement. The original core either has been or will be replaced this year. This replacement is to have a longer life and to be even more efficient and economical than the previous core. The design of this installation was primarily guided by consideration of safety and reliability. If any portion of the coolant should become excessively "hot" by leakage of fission products into the system that portion may be isolated from the rest and an alternate section introduced without halting operations.

Among the many safety features of the plant is an elaborate automatic protection system which automatically provides power cutback by rod insertion whenever any of the following situations occur: (1) Reactor thermal power is above 15% the capacity for the existing flowing conditions. (2) The starting rate is too rapid which might cause a wild chain reaction. (3) The main generator circuit breaker trips because of faults in the generator or its related circuits. Automatic scram (immediately halting operations of the core by dropping the control rods in place very rapidly) is provided whenever any of the following conditions exist: (1) Power output is 175% of rating of 60,000 kilowatts. (2) Reactor thermal power is 30% of the capacity regardless of existing conditions of coolant flow. (3) Reactor power is less than 44% of rating less than two loops of coolant in service. (There are four loops, three of which are used under normal operations, one being used only in emergencies as a replacement). (4) Reactor power is more than 44% of rating with less than three loops of coolant in operation (5) There is a loss of control voltage. (6) The temperature of the coolant exceeds 550° F (Normal temperature is between 507° F and 539° F. (7) The pressure of the coolant is less than 1600 psi which is 400 psi below the design pressure.

Rated at approximately 60,000 kilowatts, it can produce more than that if necessary without danger of overheating, until its protection system knocks it out of operation when 105,000 kilowatts are produced.

The Shippingport installation is very simple to operate as the operation the operators now perform is compensating for loss of water by leakage and sampling from the coolant. At first they also had to watch the temperature to attempt to keep it somewhat constant. Eventually the operator's job may only be monitoring the operation of the reactor for abnormal situations. The problem of handling huge amounts of coal and ash which plague conventional coal installations are absent as only pure water must be moved except during infrequent refueling operations. In addition, there are a very small number of vital auxiliaries which could necessitate a shutdown if they went out. The installation as a whole is highly stable and highly responsive to load changes.

The item to which all power companies are paying the most attention is the cost of operation per kilowatt hour of electricity produced. The Shippingport installation was the first model, so its costs include elaborate test equipment, high purity constituents for building which probably were unnecessary, excessive safety devices sometimes to the point of having a negative result, and elaborate design of all facilities for optimum performance the first time. Construction difficulties added to costs significantly. Without deductions for these excesses, the price of operation is about 64.4 mills per kilowatt hour. The nuclear fuel cost is fifteen times as great as conventional form fuel now, but times are changing.

In the testing of the plant there have been five main periods including: (1) Site construction and erection checkout, (2) pre-critical system testing, (3) initial critical testing to prove the feasibilty of the reactor design, (4) full power testing during which period the plant is operated just at expected design conditions, (5) station capability and limitation study during which time the maximum conditions of the reactor's operation are studied.

This past year Consolidated Edison Company of Chicago put a similar plant into operation on the basis of knowledge gained from the Shippingport installation. The plant has contributed much to our knowledge of reactors and nuclear energy for the solution of some of the problems of physics, materials, component designs, corrosion, and heat transfer as well as provided much invaluable data on stability under load, serviceability, maintenance, and nuclear power safety.

PROJECT PLOWSHARE

(*Continued from Page* 18)

contamination of underground water supplies is not a critical one, as the radiation is quickly absorbed by the surrounding rock.

Shock waves, similar to earthquake ripples, but much weaker, are initiated by the underground blast. In all tests thus far, these seismic disturbances seem to have offered no difficulty.

Operation Plowshare has demonstrated the feasibility of employing nuclear explosives for the purpose of general excavation. All at once, many new-fangled projects have been suggested for this recent development. One such test, Project Chariot, involves trenching a harbor on the Alaskan Coast at Cape Thompson, 350 miles above the Artic Circle, in order to aid development of Alaska's coal and oil resources. Four nuclear charges, strategically placed at a depth of 260 feet, will perform the excavation in just a few seconds. As much as twenty per cent of the radiation could be released, but this can do little harm on the barren Arctic Circle. Another facetious idea is to explode 650 nuclear weapons in order to build a one-hundred mile canal across Central America. Other propositions include recovering otherwise inaccessible oil deposits in northern Alberta, mining oil shale, supplying heat for distillation processes, and excavating underground storage basins for water.

In conclusion, peacetime use of nuclear explosives, although a young science, is destined to become a significant contribution to the fields of excavation and mining. Already, atomic devices can compare favorably with chemical charges, particularly where an immense detonation is required. As to what other applications nuclear explosives will find, we cannot determine at present. Nevertheless, rejoice in one fact. Nuclear energy is being used to create rather than to destroy, to make this a better world in which to live.

FRATERNITY NOTES

(*Continued from page* 25)

Study Proctors, John Walden and Fred Wright; Alumni Correspondent, Rod Baird; and Assistant Pledge Trainer, Tom Keeling. Congratulations are also in order for those brothers retiring from these positions for their good work.

Spring sports are now getting underway and ATO is well represented on both the baseball and track team. On the track team brothers Munro and Washburn and pledge Stegemoller will be using their abilities for Rose, and on the baseball team working for Rose will be brother Heiniger and pledges White and McNally. Brother Rapson is a baseball manager.

Congratulations go to Vern and Janice Fellows for their new addition to their family.

LAMBDA CHI ALPHA

The chapter recently purchased a 27 cubic foot food freezer, and "Mom" Rost has already demonstrated some of its advantages with ice-cream pie and the more frequent beef steaks.

In one of the "hotter" elections of the year, Fred Terry emerged as House Manager. Fred is now busily assigning house duties to seniors.

Our "Founder's Day" dinner was on March 26, 1961. After dinner Dr. Ralph Morgen and Mr. John Bloxsome spoke to the chapter and guests on behalf of the Institute. The main speaker was Mr. S. George "Doc" Dirghali, Alumni Secretary, who spoke on the aims of the chapter and the National Fraternity.

Among the post-season basketball games the actives defeated the pledges 63 to 30. Theta Kappa recently defeated the brothers from DePauw in the first game of the Indiana Lambda Chi Basketball Tournament. The remaining three games will be played on State Day, April 15.

Several of the brothers were "tapped" at the Spring Honors Convocation. Andy Hrezo was pledged by Blue Key, and Steve Ban, Jerry Badger, and Al Story were pledged by Tau Beta Pi.

SIMRELL'S

Fine Pizza

Italian

and

American

Dinners

804 S. 7th St.

Tel. C-8643

MEN

of

ROSE

Remember that

Special Occasion

Give her a Corsage

by HEINL'S

HEINL'S FLOWER SHOP

WILLIAM C. "Bill" BECKER

129 So. 7th St.

Terre Haute, Ind.

The Blossom Shop

Flower's and Gifts

Tel. Crawford

3828 and 0058

GLADY C. POUND
CHARLES D. POUND
JACK D. POUND

Ohio at Gilbert Ave.

TERRE HAUTE, INDIANA

LIBRARY NOTES

(*Continued from page* 24)

driver to have won it two years in a row.

Indianapolis 500-*Mile Race Yearbook,* by Floyd Clymer

Contains detailed accounts of the race, including the technical section, photos, charts, and drawings.

Wonderful World of the Automobile, by Ken W. Purdy

An absorbing, exciting and enlightening book on every aspect of the automobile. We use it as we use nothing else: as simple transport, as an instrument of Sport, as an indespensable arm of commerce, as a pleasure-giving device and as an indicator of our place in the tribal pecking-order.

Here you will read about the men who made automobiles, and you will learn of the passion that has made men drive automobiles as fast as they would go.

FROM THE NEW BOOK SHELF

Fate is the Hunter,
by Ernest K. Gann

The title of this book states its powerful theme in four simple words: FATE IS THE HUNTER.

One can never know when, where, or how fate will strike. Yet, sooner or later it does; and even when it misses its mark it brings terror, fear or fright to the hearts of men.

Ernest Gann regards life as a war — an undeclared war against fate, the fate that hunts men down. That is what this book is about.

Beyond the Planet Earth,
by Konstantin Tsiolkovsky

This is a fantasy of interplanetary travel by the "grandfather" of Russian rocketry. It was written at the turn of the century and finally published in 1920.

Beyond the Mountains of the Moon, by Edward H. Winter

Dr. Winter writes that the life histories of four people who live in a remote part of Ugande, members of the Amba Tribe.

These biographies give the reader an unusual insight into the operation of African society which has been brought into contact with western civilization.

FAMILY ROOMS

BANQUETS

SPECIAL PARTIES

LOUISE'S

JACK AND IDA CAMPBELL

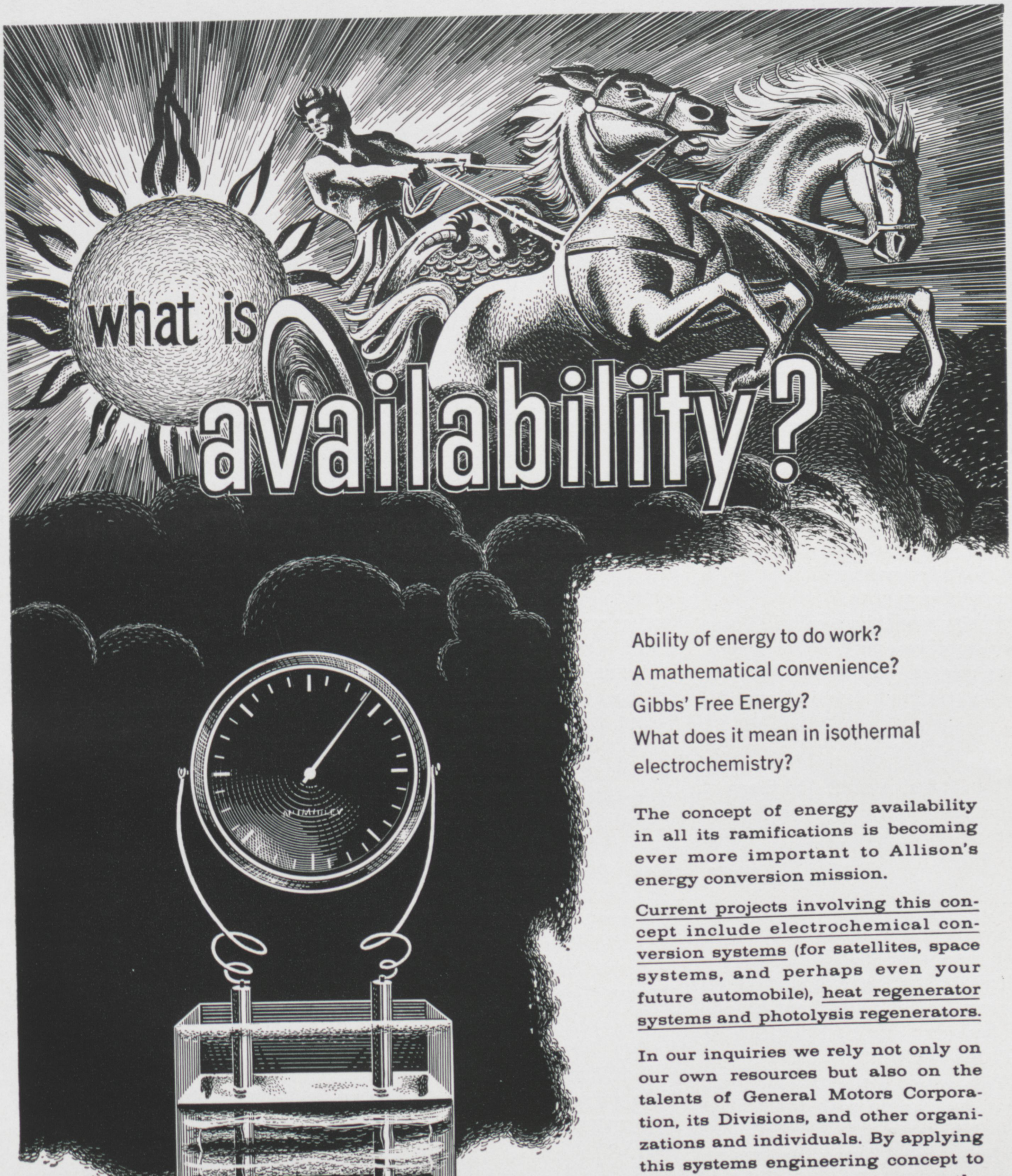
American and Italian Food

1849 South Third St.

TERRE HAUTE, INDIANA

Phone C-4989

ADVERTISING INDEX



Ability of energy to do work?

A mathematical convenience?

Gibbs' Free Energy?

What does it mean in isothermal electrochemistry?

The concept of energy availability in all its ramifications is becoming ever more important to Allison's energy conversion mission.

Current projects involving this concept include electrochemical conversion systems (for satellites, space systems, and perhaps even your future automobile), heat regenerator systems and photolysis regenerators.

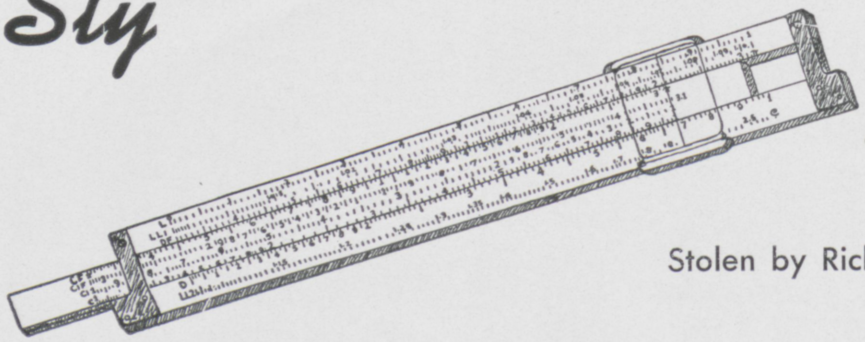
In our inquiries we rely not only on our own resources but also on the talents of General Motors Corporation, its Divisions, and other organizations and individuals. By applying this systems engineering concept to new research projects we increase the effectiveness with which we accomplish our mission—exploring the needs of advanced propulsion and weapons systems.

Energy conversion is our business

ALLISON

Division of General Motors, Indianapolis, Indiana

Sly Droolings



Stolen by Rick Rapson, soph., m.e.

A Texan had a small farm with just a few sheep. One day his wife, while dyeing some bedspreads blue, had a little lamb fall into the bucket of dye. A passing motorist saw the lamb with the blue fleece and bought it for $50. So the Texan figured he had a good thing going and colored some more lambs which brought big profits.

"Pretty soon," he recalled, "I was coloring them pink, blue, yellow, and green and you know—now I'm the biggest lamb dyer in Texas."

* * *

Papa Robin returned to the nest and proudly announced that he had just made a deposit on a brand new Buick.

* * *

A woman saw an elephant in her **yard and immediately called the police. "Chief," she said, "there's a queer looking animal out here in my backyard. He's picking flowers with his tail."**

"Yes, said the sergeant, "and what does he do with them after he's picked 'em?" '

"Never mind," was the answer, "you wouldn't believe me if I told you."

* * *

Millionaire: "Marry my daughter on and engineer's salary? Ha — Young man, you couldn't keep her in underwear."

Engineer: "There are times, sir, when you don't do so well yourself."

Not long ago, one of our city-bred engineering students was making a trip through the country. As he passed a fertile field he spied an unusual sight—a farmer helping a calving. Now our engineer didn't have the slightest idea what was happening, and he stopped his car to watch the spectacle. He could tell that the farmer was hav-having an awful time assisting the cow.

Presently he got out of the car, approached the farmer, and said, "Want some help?" And so sweating and straining, he assisted the farmer at the difficult task. Then at last, the calf was born.

Gratefully, the farmer accompanied the engineer to his automobile to see him off. But hesitating, as he wiped the sweat from his brow, the engineer looked up and said, "Say, mister, just how fast was the calf going, when it hit the cow "

* * *

If it hangs where it's supposed **to, a gal's locket is bound to be in the groove.**

* * *

It was at a sultry foreign picture in a small art theatre. The hero and heroine, after some minor plot preliminaries, went into a terrific clinch. For five minutes they remained wrapped up in each other. Suddenly a small childish voice piped up from the audience: "Mommy, is this when he puts the pollen on her?"

Why is a man eating soup with a fork like another kissing his sweetheart?

Do you give up?

Because it takes so long to get enough of it.

* * *

When you put on your cute
rayon scanties
Do they crackle electrical
chanties?
Don't worry, my dear,
The reason is clear,
It's just that you have amps
in your panties.

* * *

We heard about a Scotsman who found that he could save money by telling his children ghost stories instead of buying them Ex-lax.

* * *

"Lady, if you'll give us a nickel, my brother will imitate a hen."

"What will he do, cackle?"

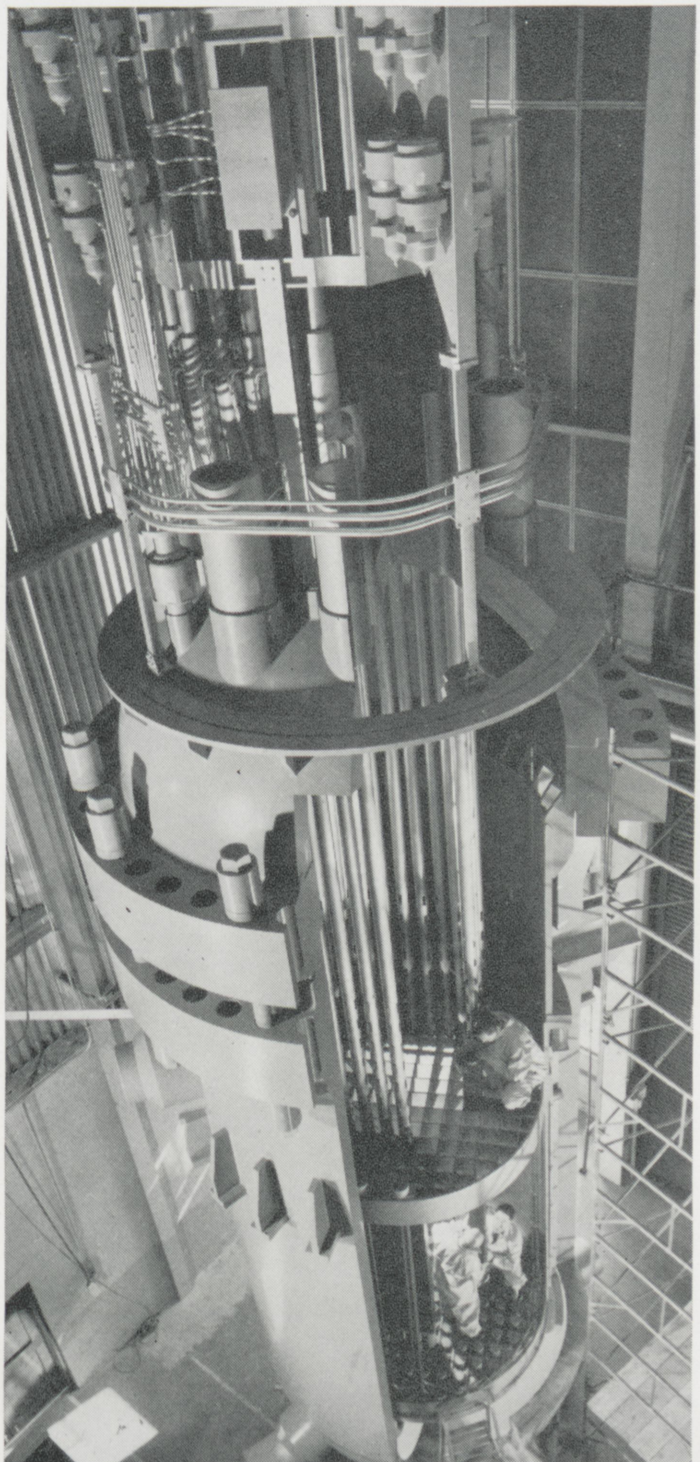
"Naw, he wouldn't do a cheap imitation like that. He'll eat a worm."

* * *

The first day of school the teacher informed the class that if anyone had to go to the rest room, he should raise two fingers.

Little Willie looked puzzled and asked the teacher: "How's that gonna stop it?"

If your sights are set  on nuclear power–



Mock-up of the Shippingport (Pa.) Atomic Power Station reactor which was designed and developed by the Westinghouse Electric Corporation under the direction of and in technical cooperation with the Naval Reactors Branch, U.S. Atomic Energy Commission.

–you'll find **Photography at Work** with you

Already engineers working with nuclear power have learned that only utmost purity of materials and meticulous accuracy in manufacture can be tolerated in a reactor. Steels for the reactors and reactor vessels are checked for make-up and molecular structure with photomicrography and x-ray diffraction. Welds are proved sound and moderators flawless with radiography. And stresses likely to occur are studied in advance with photo-elastic stress analysis.

In this new-day industry, as in any field on which you set your sights, photography plays a part in making a better product, in producing it easier, in selling it faster. It cuts costs and saves time all along the line.

So, in whatever you plan to do, take full advantage of all the ways photography can help.

CAREERS WITH KODAK:

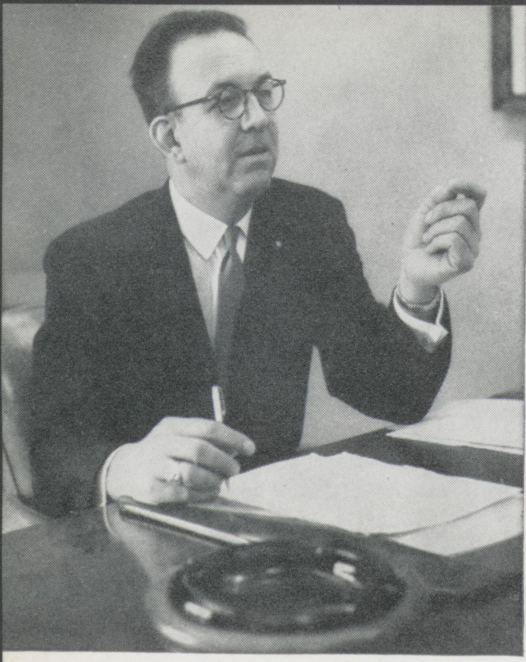
With photography and photographic processes becoming increasingly important in the business and industry of tomorrow, there are new and challenging opportunities at Kodak in research, engineering, electronics, design, sales, and production.

If you are looking for such an interesting opportunity, write for information about careers with Kodak. Address: Business and Technical Personnel Department, Eastman Kodak Company, Rochester 4, N. Y.

EASTMAN KODAK COMPANY

Rochester 4, N. Y.

Kodak
TRADE MARK



One of a series*

Interview with General Electric's Charles F. Savage Consultant—Engineering Professional Relations

How Professional Societies Help Develop Young Engineers

Q. Mr. Savage, should young engineers join professional engineering societies?

A. By all means. Once engineers have graduated from college they are immediately "on the outside looking in," so to speak, of a new social circle to which they must earn their right to belong. Joining a professional or technical society represents a good entree.

Q. How do these societies help young engineers?

A. The members of these societies—mature, knowledgeable men—have an obligation to instruct those who follow after them. Engineers and scientists—as professional people—are custodians of a specialized body or fund of knowledge to which they have three definite responsibilities. The first is to *generate* new knowledge and add to this total fund. The second is to *utilize* this fund of knowledge in service to society. The third is to *teach* this knowledge to others, including young engineers.

Q. Specifically, what benefits accrue from belonging to these groups?

A. There are many. For the young engineer, affiliation serves the practical purpose of exposing his work to appraisal by other scientists and engineers. Most important, however, technical societies enable young engineers to learn of work crucial to their own. These organizations are a prime source of ideas — meeting colleagues and talking with them, reading reports, attending meetings and lectures. And, for the young engineer, recognition of his accomplishments by associates and organizations generally heads the list of his aspirations. He derives satisfaction from knowing that he has been identified in his field.

Q. What contribution is the young engineer expected to make as an active member of technical and professional societies?

A. First of all, he should become active in helping promote the objectives of a society by preparing and presenting timely, well-conceived technical papers. He should also become active in organizational administration. This is self-development at work, for such efforts can enhance the personal stature and reputation of the individual. And, I might add that professional development is a continuous process, starting prior to entering college and progressing beyond retirement. Professional aspirations may change but learning covers a person's entire life span. And, of course, there are dues to be paid. The amount is graduated in terms of professional stature gained and should always be considered as a personal investment in his future.

Q. How do you go about joining professional groups?

A. While still in school, join student chapters of societies right on campus. Once an engineer is out working in industry, he should contact local chapters of technical and professional societies, or find out about them from fellow engineers.

Q. Does General Electric encourage participation in technical and professional societies?

A. It certainly does. General Electric progress is built upon creative ideas and innovations. The Company goes to great lengths to establish a climate and incentive to yield these results. One way to get ideas is to encourage employees to join professional societies. Why? Because General Electric shares in recognition accorded any of its individual employees, as well as the common pool of knowledge that these engineers build up. It can't help but profit by encouraging such association, which sparks and stimulates contributions.

Right now, sizeable numbers of General Electric employees, at all levels in the Company, belong to engineering societies, hold responsible offices, serve on working committees and handle important assignments. Many are recognized for their outstanding contributions by honor and medal awards.

These general observations emphasize that General Electric does encourage participation. In indication of the importance of this view, the Company usually defrays a portion of the expense accrued by the men involved in supporting the activities of these various organizations. Remember, our goal is to see every man advance to the full limit of his capabilities. Encouraging him to join Professional Societies is one way to help him do so.

Mr. Savage has copies of the booklet "Your First 5 Years" published by the Engineers' Council for Professional Development which you may have for the asking. Simply write to Mr. C. F. Savage, Section 959-12, General Electric Co., Schenectady 5, N. Y.

***LOOK FOR** other interviews discussing: Salary • Why Companies have Training Programs • How to Get the Job You Want.

GENERAL ELECTRIC